AUSTRALIA'S LARGEST-SELLING ELECTRONICS & HI-FI MAGAZINE

# ELECTRONICS Australia

SEPTEMBER, 1973

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60c*

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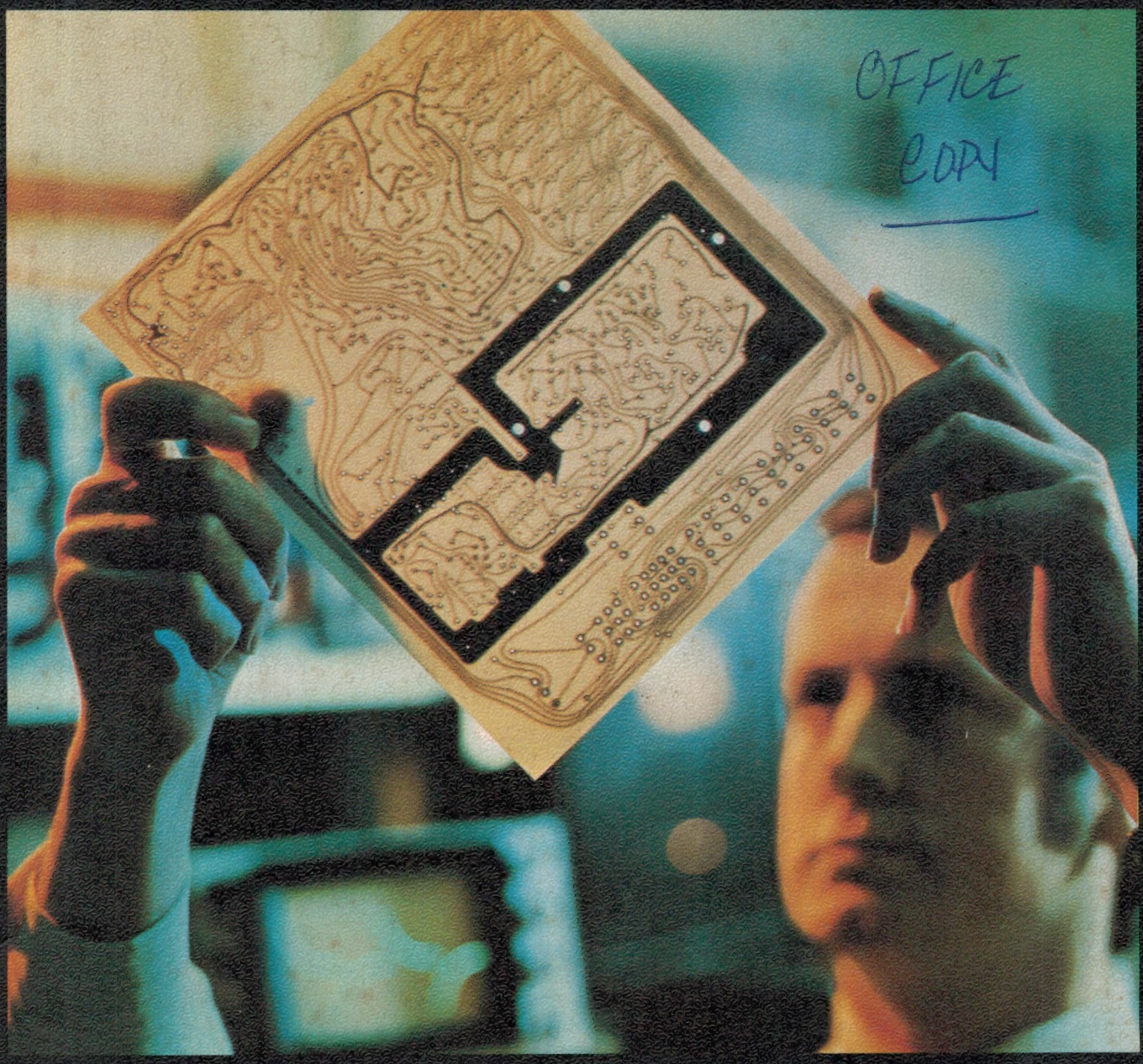


## SIGNALS FROM SPACE? * DIGITAL CLOCK TO BUILD * MAKING A 4-CHANNEL RECORDING

# SONY's answer

Superlative hi-fi doesn't come cheaply.
The ultimate runs into four figures or even more. This Sony rig doesn't. Yet only the perfectionist would ask for better than this and even he mightn't tell the difference.
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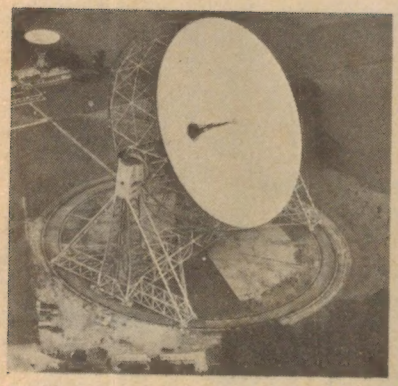
# ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 35 No 6

**Are messages from other worlds reaching** us, hitherto undetected? The possibilities are discussed in our exclusive feature story which starts on p. 16.


**Based on a new large-scale integrated** circuit, our new digital clock uses a Sperry planar gas readout with big, bright digits. The description starts on p.28.

## On the cover

An engineer at Farnell Instruments Ltd in Yorkshire, northern England inspects a printed wiring board which forms part of a 100MHz digital frequency counter.

(Courtesy British Information Service)

## CONTENTS — SEPTEMBER 1973

### world of electronics and hi-fi



### projects and technical



### regular features

# EDITORIAL VIEWPOINT

## *Action on data banks — at last*

It is good to see that at least one country has seen fit to take positive action protecting the rights of the individual against possible misuse of computer data banks. The Swedish Government has passed the world's first national law to regulate the establishment and operation of data banks, and has set up a Data Inspection Board to administer it.

The board is no paper tiger, either. When the law takes full effect in July next year, the board will have virtually full power to safeguard individual privacy where private data banks are concerned. All such data banks will be registered by the board, including payroll records, subscriber and direct mail lists and credit rating lists. There will be strict control over the type of information about an individual which may be kept, and the uses to which the information may be put.

No private data bank will be able to file highly personal information about an individual, for example. Religious and political views, arrest record, psychiatric record and all information of a similar nature will be prohibited except by special permission.

Individuals will have the right to get a free printout, in understandable form, of any data bank entry about them. An individual will be able to demand that any errors in an entry about him be corrected, or failing this that the entry be deleted. Not only this, but the individual will be able to sue the data bank if it propagates false information about him.

Although initially there will be no obligation for a data bank operator to notify an individual when he or she is entered on a file, this has apparently been considered. The law includes provision for compulsory notification at a later stage if experience shows this to be necessary.

While the new law will obviously not prevent illegal use of data bank information, I believe it does represent an important step in the protection of individual privacy. It makes official recognition of the potential dangers of data banks where the rights of the individual citizen are concerned, and institutes a comprehensive system of legal safeguards.

It is to be hoped that the governments of other countries, including our own, will take careful note of the new Swedish law, and will give serious and urgent consideration to bringing in similar legislation. The time to act is now, before it is too late.

***Jamieson Rowe***

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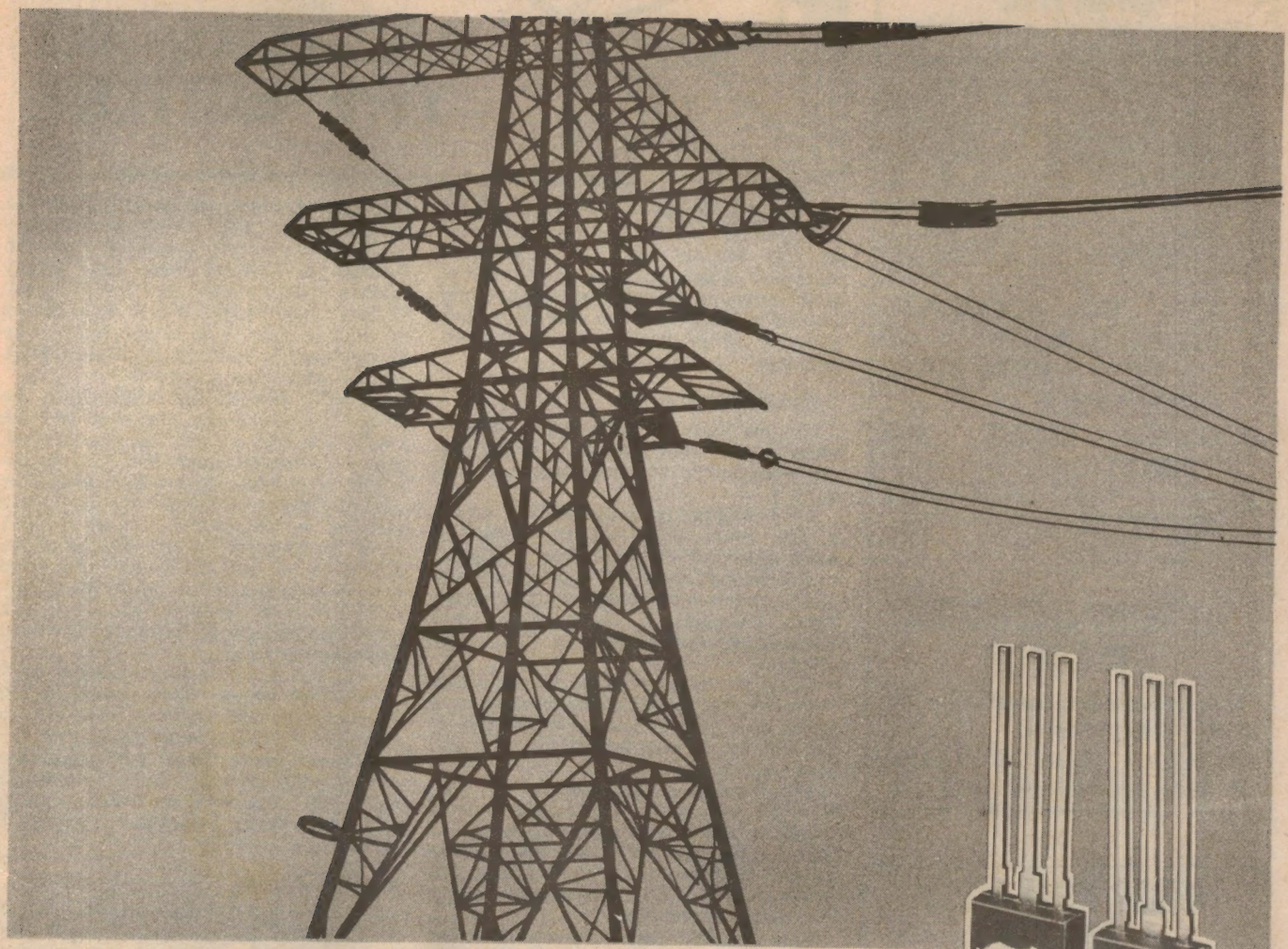
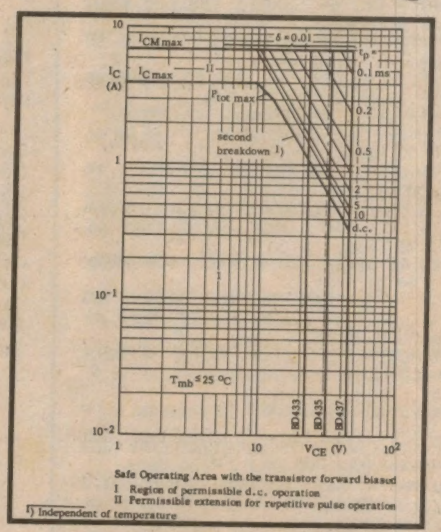


# Power problems solved
## (in a small package)

**Elcoma introduces its new range of flat pack power transistors.**

| Type No. NPN | PNP | $V_{CEO}$ (V) | $I_{CM}$ (A) | $I_C$ (A) | Ptot up to $T_{mb} = 25°C$ (W) | hFE | @ $I_C$ (A) |
|---|---|---|---|---|---|---|---|
| BD135 | BD136 | 45 | 1.5 | 1.0 | 8* | >25 | 0.5 |
| BD137 | BD138 | 60 | 1.5 | 1.0 | 8* | >25 | 0.5 |
| BD139 | BD140 | 80 | 1.5 | 1.0 | 8* | >25 | 0.5 |
| BD233 | BD234 | 45 | 6 | 2 | 25 | >25 | 1.0 |
| BD235 | BD236 | 60 | 6 | 2 | 25 | >25 | 1.0 |
| BD237 | BD238 | 80 | 6 | 2 | 25 | >25 | 1.0 |
| BD433 | BD434 | 22 | 7 | 4 | 36 | >50 | 2.0 |
| BD435 | BD436 | 32 | 7 | 4 | 36 | >50 | 2.0 |
| BD437 | BD438 | 45 | 7 | 4 | 36 | >40 | 2.0 |

*up to $T_{mb} = 70°C$




Safe Operating Area with the transistor forward biased
I Region of permissible d.c. operation
II Permissible extension for repetitive pulse operation
1) Independent of temperature

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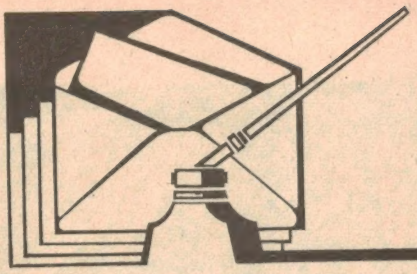


# LETTERS TO THE EDITOR

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

## 4-Channel convert

I've just finished reading the article on 4-channel Hi-Fi in the July issue of EA, and am prompted to add my thoughts on the subject.

I've been a pretty well hooked hi-fi addict a few years now, almost exclusively listening to classical music. I have followed the 4-channel saga, of course, but not wanting to sit in the middle of an orchestra while listening, I couldn't see that quadraphony had anything to offer in my situation.

However, recently I had the use of an extra pair of high quality loudspeakers for a while, so I hooked them up in the Hafler-Dynaco out-of-phase method as rear ambience speakers.

The difference was amazing! As you describe, they add a tremendous sense of depth to the sound, and a freedom of listening position which was not possible before. Your words "a feeling that the whole room was filled with sound" exactly describes my reaction.

Now, two other points: Firstly, EA is the only magazine I can think of off hand which does not have a "Letters to the Editor" or "Readers' Letters" section for letters just such as this one. I don't think the "Answers to Correspondents" pages fit the bill because the letters there are usually queries, calls for help etc. The "Forum" section can only handle two or three letters at a time, usually. It's just that I like reading readers' letters to magazines; don't ask me why! How about it?'

Secondly, prominently displayed on the Editorial page of the magazine are the words "On sale the first Monday of each month". I would suggest that you add the words "if possible, otherwise the second or third Monday of the month". Maybe you are punctual in the Eastern States, I don't know, but certainly not here. The July issue did not appear here till the 9th, and others have been as late as the 14th of the month. And if the first Monday of the month is a public holiday, why do we have to wait until the following Monday?

P. J. Croft, (Yokine, WA.)

**COMMENT: Whether or not you expected it as quickly as this, here's the section you asked for! We're interested in your reaction to 4-channel sound. We try hard to meet the official publication date on a nation-wide basis but what with staff and printing problems, power restrictions, transport hitches .....**

## Frayed Cords

I wish to suggest that the articles "A Look at Electrical Safety" have avoided the biggest hazard for the serviceman, and that is the consciousness that in repairing — or

## FREE NEXT MONTH: 64-page manual

The October issue of "Electronics Australia" heralds an innovation for the electronics industry in Australia. As part of the issue, Dick Smith Electronics of Gore Hill, Sydney will publish the latest edition of their Electronic Enthusiast's Manual. Containing 64 pages — additional to the normal content of the magazine — it will be pre-printed and stapled for easy removal.

Dick Smith, managing director says: "The publication is a manual rather than a catalog, for it meets the obvious need for technical information on products, as well as providing the usual catalog material."

The Manual will contain an enlarged section on transistors and integrated circuits and, for the first time, will include "inside" circuits and parameters of IC's. Special "Introduction" sections will aid clients in the choice of loudspeakers, microphones, &c. There are "How To" sections, and a focus on educational material, including a description of over 20 textbooks selected as appropriate for Australian conditions.

Fifty-cent discount vouchers, a feature of earlier manuals, have been retained but, in addition, there is a more recent idea, the Dick Smith "Newslette:," intended to keep customers up to date in regard to products, changes, &c.

All this will be free in your October issue of "Electronics Australia." Says Dick Smith:

"We get a lot of mail from people who evidently borrow the magazine from a friend. I hope they are going to purchase their own October issue and obtain their own copy of our catalog / manual. They will certainly want one and it will be a lot easier to acquire it in this way rather than purchase it separately by mail order."

even selling — appliances he may contribute to the death of an individual. The hazard which at present seems insurmountable is that of cable continuity and freedom from damage which results in fraying. Let me hypothesise a non-too-unusual situation:—

A builder comes in with an appliance in need of repair. The repair is effected (eg brushes in saw replaced) and, just by way of precaution the electrical safety of the tool is checked. As with most builders' equipment, the saw is metal bodied. Visual inspection at both ends of the flex show connections to be correct and safe. Earth continuity between body and earth pin shows satisfactory on a multimeter. Insulation resistance also checks adequately. Assured of the safety of the unit, the builder returns to the job.

What would you suspect if the builder died some minutes later due to electrocution? What could anyone suspect?

The fact is that all power leads have to flex, and frequent flexing leads to fraying and beaking of the conductor beneath the casing. Bruising of leads may sometimes not expose the conductor but still sever most of the strands of that conductor, as will pulling on the lead.

If the saw motor internal insulation breaks down and the body becomes live, the earth should effectively deal with that situation. However, the earth and neutral leads have been internally damaged to the extent that they fuse at 1 amp, whilst the supply fuse is rated at 15 amps. Obviously, the builder has no chance.

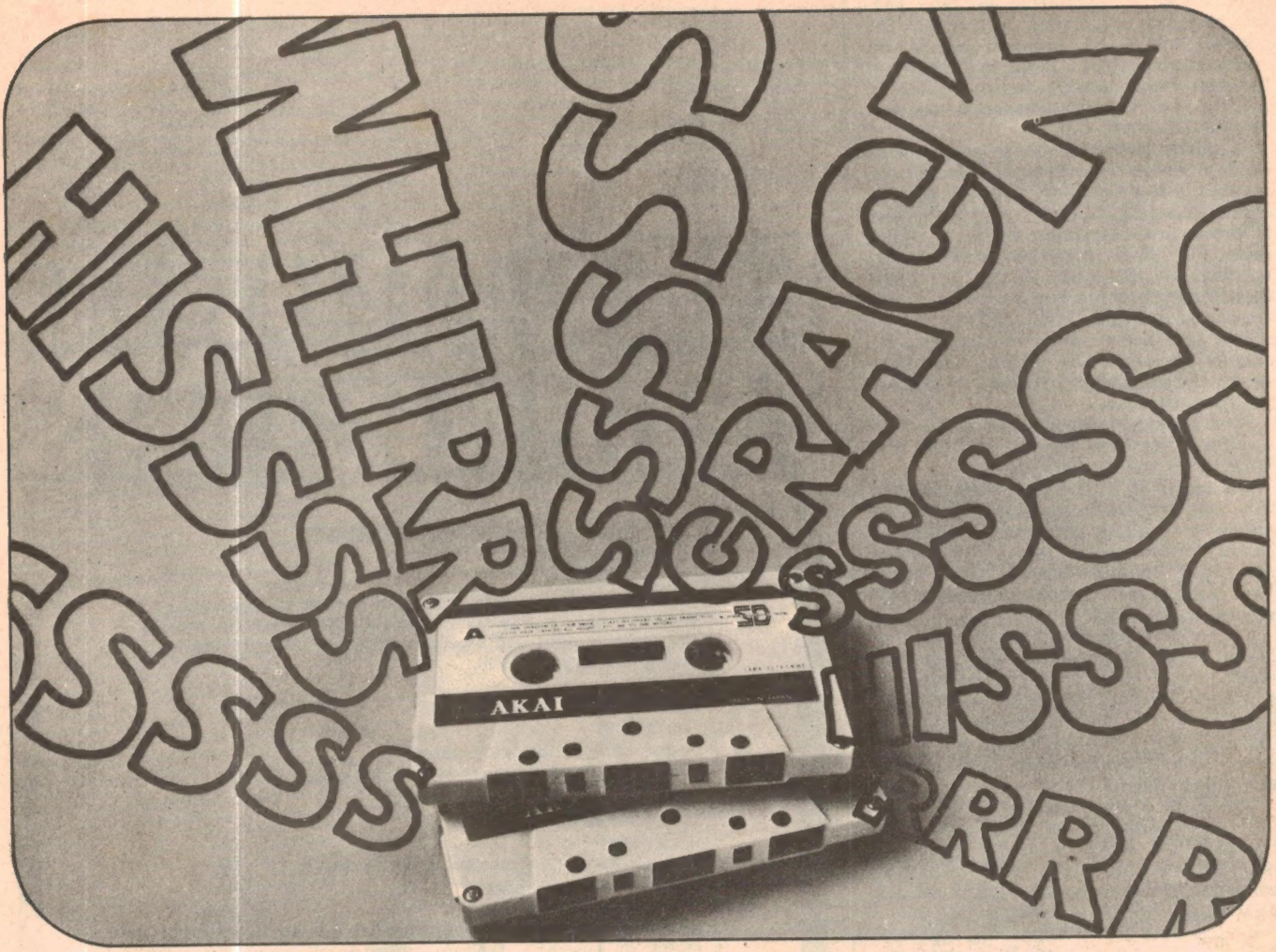
Why is there no acceptable unit on the market in Australia for load / resistance checking the safety of power leads, ie checking the resistance of a known length of conductor at its rated maximum capacity? That would indicate inconsistency.

British units available are not approved by S.E.C. (Victoria). Should the serviceman tell his customers that in Australia we cannot be sure that any cable is safe to use, unless it is fed through a core balance relay?

Of course he should. If he doesn't tell them so, he's either ignorant or a liar. How can anyone who repairs a lead sleep easy?

I'm very serious about this inadequacy. I have met with no more than "ho-hum" from S.E.C. in Victoria on the matter. I really do believe that the service industry has got to get something done to rectify a most anomolous situation: loads of safety standards which are useless in the face of one partially fractured wire.

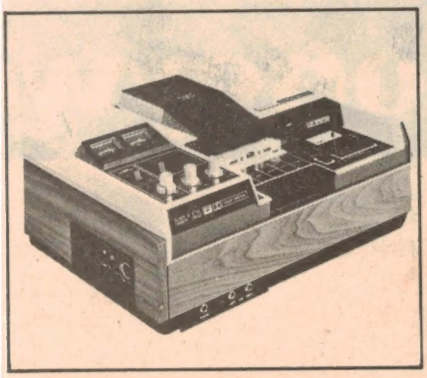
L. Junor (Diamond Creek, Vic.)




# Mr. Dolby versus the bugs

As you may know, Mr. Dolby is that clever American gent who discovered a way to take the hiss out of tape recordings. The point about the AKAI GXC 65D Invertomatic Cassette Stereo Tape deck is that they have not merely used The Dolby System to **reduce** tape hiss but rather to eliminate it altogether. The way AKAI did it was to realise that Mr. Dolby's system needed help to achieve a no noise goal.

So they added an Automatic Distortion reducing system, Overload Suppression, the much vaunted GX HEAD (with a LIFETIME GUARANTEE) and just to cap it off it flips the tape automatically. We urgently recommend that you call into your nearest AKAI dealer and enjoy a new sensation in a Stereo Cassette Tape Deck . . . Just ask to hear the bug-free deck — AKAI GXC 65D.



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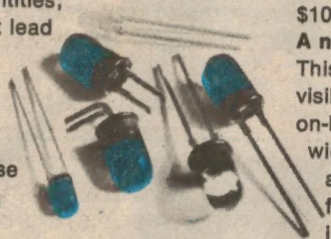
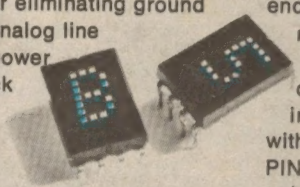
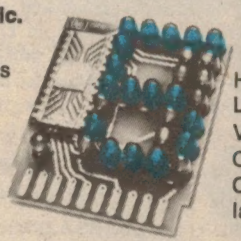


**A new low-cost isolator.** At 5 MHz bandwidth, it's 25 times faster than any other isolator on the market. It has a high DC isolation voltage of 2500 volts, and a high common mode rejection of 10 volts at 2 MHz, making the 5082-4350 ideal for eliminating ground loops in digital or analog line receivers, floating power supply and feedback networks. Prices start at $2.66 each in 100 quantities.

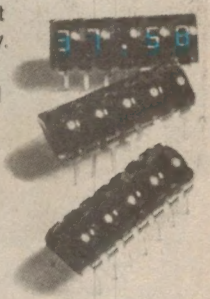


**A low-cost LED display.** Our numeric and hexadecimal displays have simplified your designs with on-board electronics, standard package configuration, and categorized light outputs. Best of all, the 5082-7300 numeric has a new low price of $10.80 in 100 quantities.

**A new 1.5" LED numeric.** This new LED display, visible from 60 feet, has on-board electronics, wide viewing angle, and is designed for edge mounting in a standard PC board socket. Solid-state reliability makes the 5082-7500 ideal where dependability is important. The price is $23.40 each in 100 quantities.



**Small character LED displays.** The 5082-7405 is a 5 digit end stackable display. minimizes power consumption and offers ease of implementation with a standard 14 PIN DIP package. At only 7 mW per digit, this display is ideal for calculators, portable instruments and anywhere that low power and high brightness are important.The 5082-7405 is priced at $2.97 per digit in 100 quantities.



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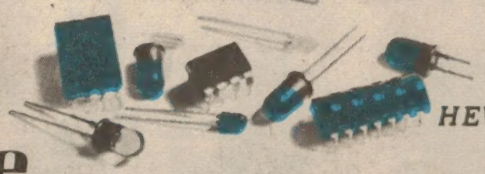

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# NEWS HIGHLIGHTS

## RAN teaching sonar using A-V techniques

The Royal Australian Navy is using audio-visual teaching machines to teach sailors about sophisticated sonar equipment more efficiently, and up to four times faster than traditional classroom methods.

Called the Audio-Visual Integrated Trainer (AVIT), the system has been used since April at the Navy's Torpedo and Anti-Submarine School at HMAS Watson, the shore establishment on Sydney's South Head.

AVIT, designed and made in Britain, uses individual cubicles which incorporate an integrated slide-tape presentation with a specially written loose-leaf book. A 35 mm slide is shown by rear projection while the student listens to a taped commentary. At programmed intervals he reads further information or answers questions in his book.

The main advantage of AVIT over other slide-tape devices is that the student controls the speed of the presentation — and thus his learning pace — from a push-button panel. Button One simultaneously plays one frame on the tape track and presents a slide, then stops. Button Two rewinds the frame on the tape track and plays the sound again without changing the slide. Button Three rewinds the tape to the preceding frame, plays the sound and shows the preceding slide (ie, goes back one sequence). Finally, a run button causes the presentation to run continuously like many other slide-tape devices.

Other buttons at the rear of the machine turn off the tape recorder and slide projector and reset to zero.

AVIT's tape recorder uses a stereo tape: one side records the commentary and the other records pulses which control the forward or backward movement of the recorder and projector, depending on which button is pushed. A logic unit counts the pulses and programmes the recorder and projector as required by the student sitting in front of the panel.

*Above shows the audio-visual integrated trainer (AVIT) teaching a sailor to operate a sonar set. A close up view of the equipment involved is shown at right.*

AVIT grew out of a training problem at the Royal Navy's Anti-Submarine Warfare School, HMS Vernon, Portsmouth, where sailors are taught how to use sonar, the sensor which guides the main control systems for underwater weapons.

A sonar set, operated by three men, is very costly and it was found impracticable to use a ship, which has a set, solely for training operators. So the RN trains operators on a shore-based sonar set simulator. But even the simulator, which costs 1m. sterling, could not cope with the volume of training. An instructor at HMS Vernon, Lt Cdr Colin Dunnett, recognising the need for a cheap, simple device to train sailors in the basic skills of operating sonar, designed an AVIT prototype with the aid of a research grant. A commercial firm produced the hardware and made 15 machines in nine months. After more than 5,000 machine hours of training, there has been no electronic failure.

Lt Cdr Raymond Green, a Royal Australian Navy instructor attached to HMS Vernon for two years, saw the AVIT classroom functioning and was impressed by the training results. Now officer-in-charge of Training Research Unit 2 at HMAS Watson, he supervises the operation and use of the 12 machines bought from the firm for about $18,000.

Although Watson is using modified RN master tapes, Lt Cdr Green is working on programmes for training sailors in radar plotting and Ikara, the Australian-designed anti-submarine missile launcher.

## Legal "burglar" attempts to steal data

In Palo Alta, California, a high school pupil who calls himself a "hired computer burglar" is trying to steal secrets from a major commercial computer network — with the company's blessing. Geof Mulligan, 15, punches codes on a teletype terminal in his bedroom to "fool the computers" and extract forbidden knowledge of anything from corporate budgets to spaghetti recipes.

"Computers are fantastic. I'm trying to break into the system and get into things I normally shouldn't be able to," said Geof, who took a computer course at Stanford University and spends up to 14 hours a day "talking" with computers.

Geof is a summer employee of Tymshare, Inc, which hired him to test its security system in Cupertino, about 40 miles south of San Francisco. Like other computer firms, Tymshare is trying to protect itself against widely publicised computer thieves who have pilfered money as well as trade secrets with intricate computer language.

Through his terminal, Geof has access to four computers and the challange of cracking the system and tapping someone else's data.

After reaching one of the computers on a telephone line, Geof gives his code name and starts experimenting with messages on the terminal. "I send a word or symbol to see what the computer responds to, how to get around the blocks and pitfalls. I try to change the program," he said. "Sometimes my friends stare when they see me talking to the computer and the machine answering back." So far, Geof says he hasn't cracked the computer.

"No computer system is completely foolproof," said Ron Batiste, public relations director of Tymshare. "Geof is a very bright boy. When you have bright people, you use them. If he succeeds, we make some changes so no one can steal information the same way again."

— George E. Toles.

# Unidata agreement signed

European electronics giants Philips, Siemens and CII have signed an agreement for pooling their resources in the data processing field. The new common data processing group, to be called Unidata, is heralded as the first step towards a world-wide data processing industry. Its more immediate effect will be to strengthen each company's position in the international market.

The three companies first announced their intention to co-operate on February 1st 1972. Since then the negotiations, conducted by senior executives and various task forces, have concentrated on working out the details. Questions to be solved before the agreement could be signed concerned marketing, product programs, manufacturing, finance, organisation, legal requirements and many others involving the three independent companies based in different countries.

Each of the companies knew that in order to expand product ranges and service networks, a much larger customer base was required. It had become obvious that the only economic way of rapidly increasing activities on a global scale would be mutual co-operation.

Unidata represents one of the largest computer groups outside the USA. Its world-wide customer base of more than 20,000 installations ranges from office computers to large-scale computer systems giving a total value greater than $US2,000 million. Resources include 35,000 staff, 14 development and manufacturing centres in 6 countries, and sales and service organisations in more than 30 countries.

# BWD export success

BWD Electronics Pty Ltd of Glen Waverley, Victoria has won a contract for the supply of dual trace oscilloscopes to the Lucknow, India, State Electricity Board. The stringent tender conditions imposed by the World Bank, which financed the transaction, included the calling of tenders world wide. BWD, whose oscilloscopes are entirely designed and produced in Australia, were successful with their Model 539A against the leading manufacturers in countries such as the USA, France and West Germany.

The company is also continuing its export success story in New Zealand, where orders for the same 539A oscilloscope recently passed the $5000 mark in less than two weeks.

This surge of activity is the result of New Zealand's colour TV programme, expected to commence towards the end of this year, combined with some enterprising salesmanship on the part of BWD's NZ agents.

The Model 539A lends itself particularly to the servicing of television receivers, both monochrome and colour, and the industry was quick to recognise this fact. The 'scope is an up to date dual-trace unit, and though designed and made in Australia, its features were designed around the diverse requirements of many countries throughout the world, including those in which colour TV servicing requirements are now well established.

# Low cost computer-graphics terminal

A high-performance, minicomputer-based graphics terminal priced from approximately $10,000 has been announced by Digital Equipment Australia. The GT40 intelligent terminal links Digital's PDP-11/10 minicomputer to a specially designed, hard-wired display processor and a 12-inch diagonal oscilloscope. A light pen, full ASCII keyboard and character set, 31 special mathematical and scientific symbols, and an APO approved serial communications interface are standard features of the GT40.

The low-cost terminal may be used either as a stand-alone graphics system or as a remote terminal interacting with various types of host computers. The GT40 will be particularly useful in the areas of graphic research, design, engineering, architecture, business information systems and other uses where a fast, low-cost graphics display is required.

*A mathematical pattern being displayed on Digital Equipment's new graphics terminal.*

# APO modem order to Philips-TMC

Philips Telecommunications Manufacturing Company Limited at Moorebank has won an order worth more than $2 million to supply its newly developed channel modems was awarded to Philips-TMC against stiff competition from Australian and overseas suppliers.

The order is for more than 700 units, which will be used as terminal translators for inter and intrastate telephone trunk lines.

As well as supplying the Australian Post Office, Philips-TMC is also supplying the modems in large quantities to the New Zealand Post Office for use in its trunk line network.

The units are among the most compact available anywhere in the world and are constructed using the latest technology. Most of the componentry is Australian. Integrated circuits and ferrities from

Philips in Hendon, South Australia, are used extensively to ensure reliability in all anticipated climatic conditions.

The modems were entirely designed and developed at Philips-TMC Moorebank to Australian Post Offices specifications. They will translate 12 telephone channels simultaneously using frequency division multiplex techniques.

# GaAs crystal grower

The first commercially available Czochralski crystal growing system specifically designed for the growth of gallium arsenide crystals is now offered by Varian Vacuum Division's NRC Operation in Palo Alto, California. The new Model 2835 is also suited for the growth of silicon, germanium, and other materials with similar process requirements.

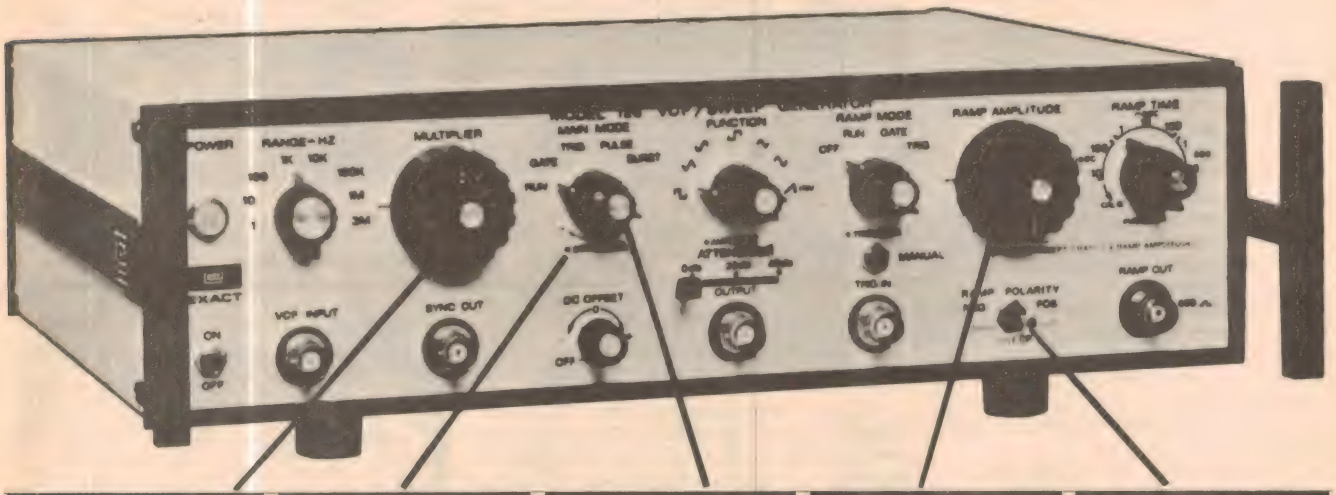
The 2835 Crystal Grower was developed to meet the rapidly expanding demand for single-crystal gallium arsenide material used in such devices as light emitting diodes. Compared with other growing methods, the liquid encapsulation Czochralski growth technique used in this new system produces a higher yield and a wafer surface that is superior for epitaxial growth processes.

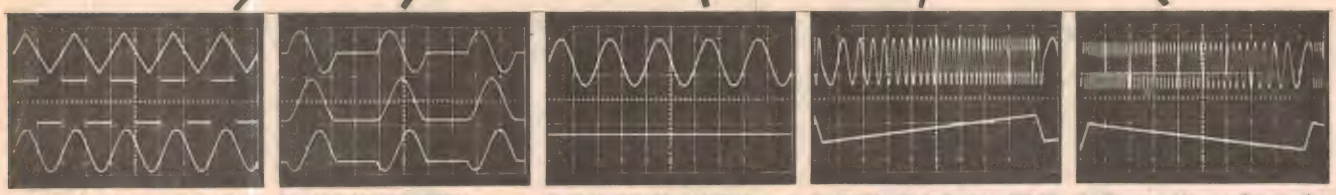
The grower is a compact, self-contained unit, ruggedly designed for the production environment. The system is complete, including a furnace, lift and rotation mechanisms, power supply and all necessary controls. This single-unit concept makes for simple, fast installation and easy

operation.

Among other significant features are an isolation valve, lubrication-free drive mechanisms, and three-phase resistance heating. The shaft seals allow either vacuum or pressure operation. There is also provision for easy access to the finished crystal and for cleaning.

# how to get your money's worth in a $495 function generator



**1. Precise Frequency Control** with Kelvin-Varley divider that gives you 10-turn resolution and stability.

**2. Variable Start/Stop** control permits varying start/stop point 360 degrees in trigger, gate, pulse and burst modes.

**3. Get DC Signal Only** out of the power amplifier to the output merely by using the trigger mode to switch off AC signal.

**4. Calibrated Sweep Width** control uses Kelvin-Varley divider to set stop frequency to let you know precisely where you're sweeping without measuring with a counter.

**5. Sweep Up or Down** the selected frequency range. Just select positive going ramp to sweep up, negative going ramp to sweep down.

## more reasons the Exact Model 126 VCF/sweep generator is the most waveform generator ever sold for $495:

**TWO-IN-ONE.** A main generator for sine, square, triangle, pulse and sync, *plus* a ramp generator for sweeping or triggering the main generator, or for use as an independent signal source.

**WIDE BANDWIDTH.** 0.1 Hz to 3 MHz frequency range, with ramp time of 10 $\mu$sec to 100 sec. (.01 Hz available on the main generator.)

**SWEEP.** Ramp generator can sweep main generator over a 1000:1 range. Sweep width adjustable from zero to 3 full decades.

**PULSE.** Independently variable width and repetition rate.

**TRIGGER/GATE.** Both generators can be triggered (one shot) and gated (burst) independently.

**SEARCH MODE.** Main generator can be swept manually over 3 decades.

**VERSATILE RAMP.** Ramp available at main output and via its own connector. (Convenient for x-y and Bode plots.) Ramp gate output connector on rear panel can be used as a pen lifter or for blanking or unblanking.

**COMPACT.** Only 3½" high, 12½" wide, 10½" deep. Weighs only 9 lbs. Simple maintenance because all components values, test points and calibration adjustments are printed on the P.C. card, identified and easily accessible.

**LOW COST.** Model 126 only $495. Model 127 with 3-digit thumbwheel frequency dials, $595. Model 128 with log sweep, ramp hold, 20 Hz-20 kHz range, $695.

•

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JM/132-73

# NEWS

## DCA validate ILS research

Research carried out by Sydney University to investigate the way in which interference can be caused to instrument landing systems (ILS) by aircraft adjacent to runways has been validated by a DCA research team. Their findings have confirmed the validity of the research approach taken by the university team, which was to use a 1 / 30th scale model of a runway and aircraft.

The original research, by the Air Navigation Group from the Sydney University Electrical Engineering School, was carried out at the disused airport at Fleurs, in NSW. Under its leader Dr Godfrey Lucas, the team used an exact 1 / 30th scale model to analyse the way in which aircraft parked or taxiing adjacent to an airport runway can interfere with ILS operation. The preliminary findings of the research aroused world-wide interest from aviation bodies.

But the crucial test came recently when it was decided to verify the findings using full sized aircraft. The verification was carried out by a DCA research team, at Avalon Aerodrome near Geelong, Victoria. Qantas loaned a Boeing 747 "jumbo" for the tests, and this was used as the "interfering object". Measurements of its effect on ILS operation were made using a specially-fitted Douglas DC3.

The results closely matched the predictions from the research by Dr Lucas' team, and were judged sufficiently important to be presented at the annual meeting of the ICAO ILS and Calibration Sub-Group, which met in Ottawa a few monghs ago.

With the validity of models in this type of research established, the Fleurs facility is now being used for further research projects, including one for the US Federal Aviation Administration.


*At top, Dr Godfrey Lucas (left) discusses the positioning of model aircraft with Senior DCA Navaids Engineer Wes Willoughby. Above shows DCA trials being carried out to test the results obtained from model experiments.*

## Sites being considered for Project Sanguine

The US Navy is reported to be considering two possible sites on the US mainland for location of transmitting grids for Project Sanguine, its proposed command communications system for ballistic-missile submarines. Project Sanguine is intended to launch commands to US submarines throughout the world in the event of a nuclear attack, and is designed to be virtually "unjammable". If implemented, it will use a carrier frequency in the low audio range — between 30 and 100Hz. Transmitter output is to be in the vicinity of 10 megawatts, fed into conducting grids between 40 and 80 miles square buried in the ground.

Low ground conductivity is essential for transmitting efficiency, so that the transmitting grids must be buried above a rock shelf. Suitable shelves exist in Michigan, Texas and Wisconsin. The preferred location at present seems to be the Llano Uplift area in Texas, about 45 miles NW of Austin, while the second site is on the Upper Michigan peninsula.

Receiving aerials for the extra-low frequency signals would be very long wires trailed out behind the subs, in order to clear the noise field produced by the sub itself. Because of the very low carrier frequency, special message compression and formatting will be necessary before the signals are digitally encoded and used to phase modulate the carrier using a minimum-shift keying technique.

## *CETIA exhibition*

"Government policies and the electronics industry" will be the theme for the opening seminar of the 1973 CETIA Congress and will provide a fitting commencement to the 4th International Control Electronics Telecommunications Instruments Automation Exhibition which will be held from September 17-21 at the RAS Showground, Sydney.

Adding further authority and attention will be the participation by the British Electrical Manufacturers' Association, the Automation and Control Manufacturers' Association and the Australian Atomic Energy Commission. Over sixty Australian companies will also provide an exceptionally strong line-up of exhibitors.

The Program Organiser has already announced that the 1973 International CETIA Exhibition and Congress will be the largest and most intensely represented since the Program was established in 1968. All the new instruments, electronics and components, electrical engineering, pollution, water treatment and process control, communications, fluid power, laboratory equipment, computers and systems will be on display at CETIA '73.

Sponsoring organisations include Electronics Association of Australia, National Association of Testing Authority, the Clean Air Society of Australia and New Zealand and the Non-Destructive Testing Association of Australia.

# DICK SMITH & STAFF — SUPER VALUES

## Fantastic Fibre Optics

- **Bend light round corners**
- **Build decorative light sprays**
- **Experimenters dream**

Dick's done it again. Fresh back from overseas with Fibre Optics kits. Enter the magical world where these fibres defy nature — amaze your friends with light that shines round corners, in and out of water etc!
This space age development transmits light very efficiently cutting out heat transmission. You can bend the fibres, cut them, even tie them in knots . . . there's no limit, so let your imagination run riot.
Flexible trouble light — easy! Colour organ — a snack! Alpha-numerical display — a dawdle! Strange lamps — well we've seen similar things for over $200!
If these kits go anything like the solar-cell sell out, you'd better write now or envy your friends forever.

**Experimenters kit.** Contains two large bundles of 15" fibres preformed to a walking stick shape (there must be many hundreds of them) plus 18" length of jacketed light guide. You also get the special eyelet terminations, conical wedges and some precision plastic tubes for building your own guides. Comes complete with a fascinating manual explaining how they work and various uses. Only needs a light source. **$8.50 (P&P 30c)**

**Fan display.** Simple, beautiful, this fan of hundreds of free-flowing 20 mil fibres only needs a lamp base to make it a real talking point (If you really want people to rave you'll also need a draught!), light source extra. **$9.50** (P&P 30c)

**The Umbrella.** A sparkler, this one consists of 11" fibres (too many to count) in a 3/8" termination. Makes a fantastic display on Managing Director's polished rosewood desks. Creates a great impression for only **$8.75** (P&P 30c) lamp extra.

**Universal lamp base.** You can make your own but this one is specially made for the job in beaut black. Suits any of the kits. Complete with low wattage lamp and base, ready to wire and take the fibre optic termination. **$9.75** (P&P 50c).

Take a look at these outstanding features.

**NEXT ISSUE**

## SITUATIONS VACANT

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We're looking for some really keen enthusiasts to come and help us maintain and improve the standard of our mail order business. You'd need to be at least 105% thorough because we can't afford mistakes. The business is growing very fast and we're finding it difficult to get the sort of dedicated enthusiast, like ourselves, to help keep people, like you, happy.
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Write to Dick Smith now telling him your age, qualifications (eg amateur licence but really we're looking for thoroughness and enthusiasm) relevant experience etc and who knows?

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**FREE IN THE OCTOBER ISSUE OF ELECTRONICS AUSTRALIA**
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If you usually borrow Electronics Australia from a friend, DON'T. Get your own copy in October and get Dick's world famous catalogue completely FREE. Don't wait to see your friend's copy and be disappointed because the magazine has sold out. Hurry down to the newsagent and place your order now. Invest 60 cents in the October Electronics Australia and get Dick's 50 cent catalogue completely FREE (it's cheaper than sending for the catalogue on its own!) The issue must be a sell-out. So if you're a hobbyist, amateur, serviceman . . . in fact if you're anyone you'll need a copy handy. Just check the contents:

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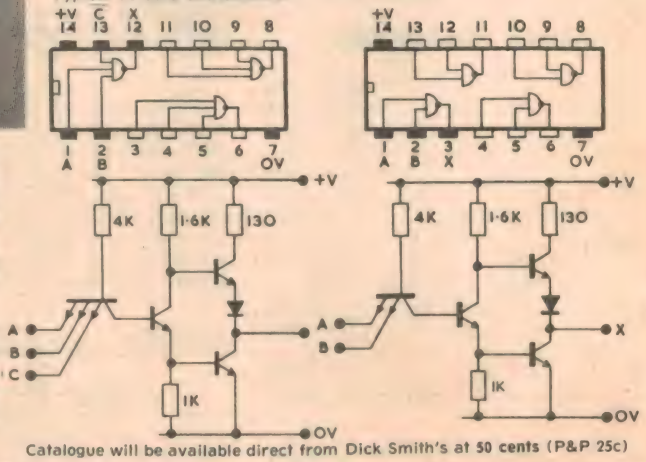



Catalogue will be available direct from Dick Smith's at 50 cents (P&P 25c)

**Dick Smith Electronics, Pty Ltd 160—162 Pacific Highway, Gore Hill NSW 2065. Phone 439 5311**

NEWS

# New cables under Sydney harbour

Post Office crews recently laid six heavily armoured telephone cables, each about 600yds long and and about 12 tons in weight, across Sydney Harbour with the assistance of divers. Each cable contains 600 pairs of wires and they will be used as junction cables — that is, cables which connect one telephone exchange with another.

The big submarine cables were made for the APO at the Liverpool factory of Austral Standard Cables Pty Ltd. They are 9cm in diameter and much heavier than comparable land cables because of lead sheathing and protective armouring.

The efficiency of the lead sheath in keeping out water is proved in the factory by filling the cable with dry air at a pressure of 60lb per square inch for three hours. Its electrical characteristics are tested again before the cable is delivered, with the ends sealed and pressurised to between 8 and 12lb psi.

Heavy armouring is necessary because of the possibility of accidental interference in the busiest part of the harbour — between Milson's Point and Dawes Point — and the conditions of the harbour bed, including the presence of numbers of existing Post Office cables.

The purpose of the harbour crossing was to join the cables at Milson's Point to other cables pulled into some of the 133 miles of PVC ducts laid recently on Sydney's North Shore.

It is normal practice to use 1200-pair cables on land for junctions, but because of the size and weight that would be involved in a submarine cable of that capacity the APO prefers to split the line into two 600-pair cables for underwater sections.

Two of the across-harbour cables were to be joined to land cables to provide new junction routes between Chatswood and the Pitt exchange in the city; another two for junctions between the Chatswood and Haymarket exchanges, and the third two connecting the North Sydney and York Street exchanges.

# AWA wins military receiver contract

Amalgamated Wireless (Australasia) Ltd has been awarded a contract for more than $2.6 million by the Department of Supply, on behalf of the Department of the Navy, for several hundred general purpose, military high frequency communications receivers of Australian design and manufacture.

This equipment is the result of nearly eight years of engineering study and design by the AWA Engineering Products Division at North Ryde, NSW in addition to user specification and model testing and evaluation by the Departments of Navy and Supply.

The AWA CRH-11 receiver is a successor to the international class communications receivers designed by the firm in the early 1950's, of which some 350 were manufactured and which remain in service in 1973 in major international radio systems throughout the world. The new equipment, with a volume only 1/100 the size of its predecessor, represents many firsts in electronics technology both in design concept and performance achievement. It is exclusively solid state; has no electro-mechanical parts or motors; is fully electronic in all its functions, and can be operated manually or programmed as part of a computer-controlled communications system for remote operation by digital processes.

Patented protection circuits enable the receiver to be co-sited and operated conjointly with high-power transmitting equipment without damage to the receiver circuits. The very rugged modularised construction and the use of the highest grade of components and integrated circuits provides a most reliable and easily maintainable equipment suitable for employment in military tactical roles, in ships and submarines, and in mobile or transportable communications as well as in international class fixed-station systems.

The performance characteristics of the CRH-11 receiver demanded the development of new instrumentation techniques by the Department of Supply in their evaluation of the design, which AWA claims to be the most advanced receiver in the world for use on the HF band.

# Liquid crystals course

Electrically operated liquid crystal alpha-numeric displays are now being used in ever-increasing quantities in digital instruments, wrist watches and even in race-course and stock market displays.

Because of their intriguing physical properties and great industrial application potential, liquid crystal research is pursued today at many universities and industrial research laboratories overseas, notably in USA, England, France, Japan and Germany.

In keeping with the growing interest in Australia, on November 12-16, a short introductory course on liquid crystals is being conducted for the first time at Macquarie University. The course is to be given by Professor Glenn H. Brown, Director of the Liquid Crystal Institute, and Professor of Physics Alfred Saupe, both of Kent State University, on the occasion of their visit to Macquarie University.

The course is open to staff and students in universities and colleges, but most importantly to application-oriented people in industrial research and non-destructive testing laboratories, and anyone wanting to update his or her knowledge on liquid crystals.

The course covers almost every aspect of the liquid crystal field. The lectures on each topic will be followed by an open discussion session. On Friday, November 16, a half-day Liquid Crystal Conference will be held, with a series of short papers presented by Australian authors.

The course ends with a forum on liquid crystals which enables the participants to inquire about any aspect of the present state of art in liquid crystals.

A detailed lecture program, timetable, registration forms and further information can be obtained from E. Laisk, School of Mathematics and Physics, Macquarie University, North Ryde, NSW 2113, or dialling 88 9227. Pre-registration at an early date is desirable.

# VCR copying company in production

The first TV-production company in Europe able to transfer TV programmes to VCR cassettes in large numbers is now ready to start production at a capacity of 1,000 copies every 24 hours. The company is the privately-owned Danish TV company Telscan, which recently celebrated the start of production at a reception in Copenhagen.

The Danish Philips organisation has supplied the major part of the company's equipment. This comprises two outside broadcast vehicles, in the larger of which are two colour TV cameras LDK5. The vehicle is prepared for a third camera. Five colour and four black-and-white monitors as well as all mixing and control facilities are also installed in this vehicle. On the audio side, the equipment comprises an MM-2 audio mixing desk with ten input channels, two "Pro 12" tape recorders and commentator and intercom equipment. The smaller of the two vehicles is equipped with an LDK 13 portable camera, colour and black-and-white monitors, a mixing desk with four input channels, and one "Pro 12" tape recorder.

For the technical control centre of Telscan, the Danish Philips organisation have delivered multiplex telecine equipment for the scanning of slides and 16 and 35 mm films, a production control panel, a subtitling unit and a mixing desk for audio and video. A complete copying unit comprising 50 slave units has been delivered for the copying of VCR cassettes.

Telscan regards itself as "an electronic printing house". However, it has also started making its own production: news programmes for shipping personnel, as well as various experimental programmes.

*WORLD EXCLUSIVE FEATURE STORY:*

# Messages from space

At a recent meeting of the British Interplanetary Society, Scottish astronomer Dr Duncan Lunan advanced the theory that an alien probe is circling the earth in the same orbit as the Moon. Dr Lunan arrived at this theory after considerable research into the phenomenon of long delayed radio signals. Currently working with Dr Lunan is Mr Anthony Lawton, a space communication and computer expert. The two are planning to experiment further by scanning the probe's most likely location with a powerful directional antenna. In this exclusive article, Anthony Lawton describes some of the possible methods by which communication with alien intelligence might be achieved.

**by A. T. LAWTON AMIEE, FRAS, FBIS**

The controversial topic of communication with extra terrestrial intelligence (CETI) is a current research project to which many of the world's leading radio astronomers are devoting a great deal of time and study. When considering CETI distances in terms of light years in free space are involved, and with our present knowledge we are forced to consider modulated electromagnetic radiation (EMR) as the only feasible carrier of energy for these long distances.

Within the next 50 years EMR communication systems will have developed to the point where only natural and economic elements will limit the distance of communication. These limiting factors include:

(i) the quantum noise limits set by free space, our aerials, detectors, and receiving equipment;

(ii) the strength of materials which set the size and areas of transmitting and receiving systems;

(iii) the percentage of the world's energy we are prepared to devote to CETI; and

(iv) the percentage of the gross international product and priorities we are prepared to devote to CETI.

Several methods can be considered for CETI. Some of them may be actively and economically used now others will be available as our technology improves. These methods include:

(i) transmission and reception on radio frequencies of 1-100 GHz;

(ii) transmission and reception on optical wavelengths of 30um (infra-red) to 0.3um (ultra-violet); (iii) the detailed investigation of any anomalous radio signals that may be received; and

(iv) modulation of the Sun's emitted spectrum either by chemical 'doping' or laser transmission.

The first of these methods (ie, the transmission and reception of radio signals) generally employs systems operating at 1,420 MHz, the emission frequency of neutral hydrogen. Since the conception of Project 'Ozma' enthusiasm for this method has been revived, particularly in Russia where CETI is taken very seriously.

The Russians have initiated a definitive CETI program to examine the 100 nearest stars for signs of CETI signals. At present the largest radio telescopes in Russia are being used on the project. The prospect of eventually using the giant 600 metre 'Ratan' steerable 'ground dish' raises the number of potential candidates to over 1,000. Of the 100 candidates in the present Russian program, 12 have already been screened out.

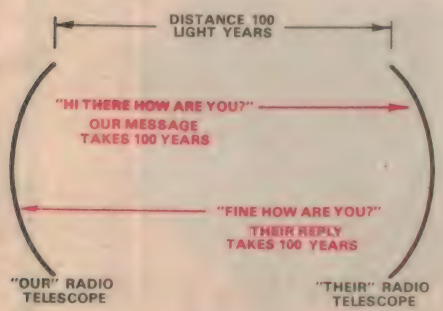
A detailed study of a gigantic aerial system has recently been made in the United States. Called 'Cyclops', it is designed to catch even the faintest radio signals over a wide frequency range. The system will probably never be built, partly because it is too expensive, and partly because if the system is so sensitive then it is more likely to detect man-made or (more likely) world wide natural radio noise.

The transmission and reception of radio signals on wavelengths other than 21cm (1,420 MHz) is currently being researched. The wavelengths regarded as being most suitable are (i) 1.8cm (16.6 GHz), the OH hydroxyl line; (ii) 1.25cm (24 GHz), the ammonia line; and (iii) 0.4cm (75 GHz), the formaldehyde line.

Although it is possible for us to receive such frequencies, at our present stage of development we could not transmit at the power densities required to achieve interstellar distances. We are just barely able to manufacture high power klystrons and magnetrons working at 1.8 and 1.25cm, but cannot yet produce devices functioning at 0.4cm. We do not at present know how to manufacture masers or plasma systems to operate at the required power densities, and must therefore expand our present technology.

Transmission and reception at optical frequencies is another feasible system for CETI. Similar power levels to those at radio frequencies can be raised by lasers, particularly at infra-red wavelengths where peak powers of 5 megawatts at efficiencies of 25 percent are achieved with comparatively simple apparatus. The author has proposed the use of infra-red interstellar communications systems (IRIS), on the premise that another CETI community may have opted for IRIS for economy reasons. At a given resolution and power per steradian this would cost less than for a comparable radio telescope system.

A systematic infra-red survey might reveal some extremely interesting




*DIRECT RADIO communication with a star system 100 light years away would involve considerable delay, as shown by Fig. 1 above. The facing page shows the author, Anthony Lawton with the aerial being used to search for an alien probe.*

# salute the Sansui models

# 210A and AU-101

**SIMPLY THE MOST OUTSTANDING (AND BEST VALUE) STEREO AMPLIFIERS AVAILABLE IN AUSTRALIA TODAY.**

**Both are in great demand — both have received *"rave"* reviews in highly respected technical publications . . . and it's not surprising, for in terms of sheer performance, the Sansui models outclass similarly priced equipment, and even effectively penetrate the market of some products *twice the Sansui price.***

**MODEL 210A.**

Sansui designed and manufactured the Model 210A stereo tuner/amplifier specifically for Australian conditions — yet the maximum price you will pay is $213.50. Output is 42 watts R.M.S. into 4 ohm speaker systems and the conservatively quoted frequency response is 25-30,000 Hz. ±2dB. Distant stations are received easily, for the 210A is the *most selective tuner/amplifier ever made by Sansui.*

See all the features and listen critically when you visit your franchised Sansui dealer!

**HEAR – COMPARE – AND BE MORE SATISFIED WITH SANSUI!**

**MODEL AU-101**

In the review in "Electronics Australia" (August, 1973) you will read . . . "the best comment we can make about the AU-101 is that few amplifiers, regardless of price, give an overall test result as good as this". Need we say more?

The most you will pay for the AU-101 is $149, and it could well be less than this when you visit your franchised Sansui dealer . . . for trade-in valuations can make a world of difference.

**Now look at the AU-101 specifications:—**
**Power output:** 36 watts R.M.S. at 4 ohms, 30 watts R.M.S. at 8 ohms.
**Frequency response:** 20-60,000 Hz ± 2dB
T.H.D.: Less than 0.8% at full rated output.
**Channel separation:** Better than 45dB. **Input sensitivity:** 3mV.

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Melbourne, 3000.

Please send me complete technical details on the Sansui Model 210A/AU-101 and the name of my nearest Sansui dealer.

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SSA-573


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*Atkins Carlyle Limited, 1-9 Milligan St., Perth. Tel. 22 0191.*

***Sansui equipment is manufactured by:*** *Sansui Electric Co. Ltd., 14-1 2-chome, Izumi, Suginamiku, Tokyo, Japan.*

anomalies, for example stars which are visually single but IR binary with one of the IR sources pulsating. A partial survey of 21 IR stars has already been carried out, with the intriguing possibility that Proxima Centauri is not the nearest star beyond the Sun.

Having established a system on a search basis, any possible 'messages' will have to be recorded and decoded. Before decoding could be attempted, the records would have to be checked for:

(i) coherence, ie, correct sequence multiples and not random pulses;
(ii) elimination of natural causes, pulsars etc;
(iii) elimination of man-made causes, ie, deliberate fakes or accidental interference caused by harmonics from items on a different wavelength, or cyclic motion of the recording gear.

The latter two possibilities may be checked by moving the aerial. If the signal is unchanged it is man-made; if the signal changes it is a pulsar or CETI. Since there are now over 60 known pulsars it is quite possible that any CETI may be accidently classed as a pulsar.

However, most pulsars seem to radiate their peak radio powers at wide bands around 200 to 800 MHz and we are looking for 1,420 MHz narrow band (10-100 Hz) CETI. Therefore, a pulsating source should be checked over a very wide frequency range and any narrow band emission regarded as a possible CETI candidate.

One aspect of CETI that is currently receiving a lot of attention is the unexplained phenomena of long delayed radio signals. The first known statement concerning anomolous radio signals were made by Nikola Tesla. In 1928 long delayed echoes (LDE's) were reported by Carl Stormer, Professor of Mathematics at Oslo, and Van der Pol, head of Radio Telecommunications Research, Philips, Eindhoven. These echoes were always characterised by time delays varying from 3 to 30 seconds after transmission, and were clear and free from Doppler shift.

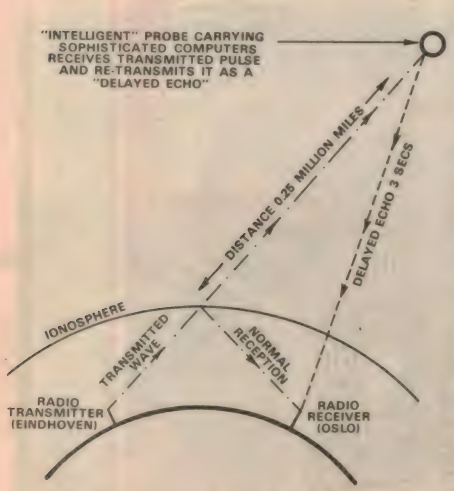



*Fig. 2: The way in which an alien probe orbiting the earth could be responsible for the long-delayed echoes observed by Stormer in Oslo on 11th October, 1928 using the signals from station PCCJ in Eindhoven, Holland.*

*THE AUTHOR with colleague Dr Duncan Lunan, the Scottish astronomer who supports Professor Bracewell's theory of an orbiting alien probe.*

To receive a 3 second echo demands a reflecting body approximately 440,000 km from Earth, ie, a Moon orbit. An echo received 15 seconds after the transmitted pulse demands a surface at 2.24 million km from Earth. There are other propagation methods which can produce such echoes, but they are complex and the exact conditions are, as yet, unknown. They postulate maser action in the ionosphere, ducted propagation, and multiple round-the-world ionospheric reflection.

Considering the normal state of the ionosphere, the fact that the echoes show little distortion or frequency shift is surprising. Furthermore, any reflecting surface good enough to ensure the high quality of the echoes should be stable enough to reflect several consecutive signals at the same time intervals.

In 1960, Professor Bracewell of Stanford University suggested that LDE's emanated from an alien probe in the solar system. To satisfy the 3 second minimum delay time obtained by Stormer, Van Der Pol and Bracewell the probe would have to be circling the Earth at the same distance as the Moon. This theory has recently received considerable support from Scottish astronomer Dr Duncan Lunan.

To achieve CETI presents enormous technological and communication problems. Perhaps the greatest enemy of all is time — for if, in fact, we do achieve CETI with a star 100 light years away (for example) then it will take 200 years for us to receive a reply to any messages we may transmit.

CETI from a relatively "local" probe simplifies most of the problems in that the technology load (noise, power, time, money, etc) is taken on by the probe's designers. Furthermore, if aliens can send into our solar system a device that has travelled over light years in a radiation-hard environment and decelerated itself into orbit around the Sun (or Earth), then we need not worry about communication problems. Such problems will doubtless have been foreseen and set to match our limitations, not theirs.

The intelligent probe method is the only way to achieve specific direction for CETI research as it avoids the semi-randomness of searching out the possibilities (even though the effort is reduced by looking at the 'right type' of star). To find and identify such a probe could provide us with an enormous amount of information. Apart from what was programmed into the probe by its designers, we would feel impelled to investigate its construction methods and, if possible, to see and touch it.

Based on the laws of probability, we have good reason to believe that we are not the only form of life in the universe, and we are beginning to search for signs of alien intelligence. Perhaps the best closing comment is from Dr Frank Drake, who wrote this preface in Project Cyclops:

"At this very minute, with almost absolute certainty, radio waves sent forth by other intelligent civilisations are falling on the earth. A telescope can be built that, pointed in the right place, and tuned to the right frequency, could discover these waves.

"Someday, from somewhere out among the stars, will come the answers to many of the oldest, most important and exciting questions mankind has asked."

# $10m Darwin-Mt Isa link nears completion

Spanning 1,000 miles of desert between Darwin and Mt Isa, Australia's new $10,000,000 microwave link is nearing completion. Consisting of 43 repeater stations, some up to 250ft high, the new system will enable Darwin to dial direct to almost anywhere in Australia.

by PETER THOMAS

Work on the $10,000,000 microwave radio system between Mt Isa and Darwin — a major addition to Australia's broadband telecommunications network — is proceeding as planned towards completion in mid-1974.

The system will have an initial capacity of 1,200 channels to provide telephone, telegraph and data communication facilities for a vast area of Australia's north, and will link Darwin into the national subscriber trunk dialling network. Some of the channels will be used for interstate communications and others will provide facilities between Mt Isa, Tennant Creek, Katherine and Darwin.

Along its 988 mile route, the system will be built up of 43 repeater stations whose sites were chosen after extensive ground and aerial surveys. The repeaters, spread every 20 or so miles along the route, have self supporting steel towers to carry the radio antennae. Some of the towers are 250 feet high as the antennae must be within sight of the stations to either side. The towers are designed to withstand winds of 100mph or more.

At each station, the radio signals must be amplified and re-transmitted to the next link in the system. Amplification and transmission equipment is housed in transportable all-metal buildings at the base of the towers.

Because of the harsh climatic conditions along the route, the repeater stations are fitted with 'ice bank' air conditioning units. These units store up to 3,000 lbs of ice made during the night and cooler parts of the day. When cooling of the equipment rooms becomes necessary, water is circulated over the ice bank and through a heat exchanger, keeping the room temperature and equipment at regulated operating temperature.

An ingenious system of automatically controlled louvres will operate in conjunction with the 'ice bank' air conditioning. Gas pressurisation equipment used in the system will switch itself on and off automatically as air supply requirements in the stations demand. From the equipment's storage tank in each microwave station a supply of air will be drawn to operate the ventilating louvres at intervals determined by time and temperature factors.

Except for the stations at Mt Isa, Tennant Creek, Katherine and Darwin, the repeaters are designed to operate continuously without staff. These unmanned stations have their own power generators and all the radio equipment in the stations is duplicated to cover any failure which may occur during operation. An inbuilt signalling system warns the nearest manned station of any fault which may occur at a repeater. Until repairs are made, the standby equipment automatically cuts into service and ensures continuity of communication.

The alarm signalling system installed at the repeaters covers every phase of the stations' operations. Any interference to station buildings or equipment will be relayed immediately to the nearest manned station.

When the Darwin-Mt Isa link is brought into operation the most frequent visitor to the repeaters will be the fuel contractor. A special fitting accessible from outside the surrounding fence enables the contractor to deliver fuel direct from his vehicle to the tank. A high level alarm is fitted to the fuel gauge and indicates to the supplier when the tank is full.

During construction and installation of the microwave system a special 30 man Post Office team headed by Project Manager Max Kimber of Darwin is


*Above is a partly completed radio tower under construction, while at right a technician aligns the antenna on one tower with the antenna on an adjacent tower.*

supervising every phase of the project. The majority of work is being carried out by contractors, and Australian made items make up the major part of the job.

The complex alarm signalling system is being installed by a skilled team of technicians under the control of project engineer Mr Volker Lange. Mr Lange recently visited Italy to discuss equipment performance and design with the company supplying equipment for this important part of the project.

So far, all towers along the route have been built and the station buildings have been erected between Mt Isa and a site north of Katherine. Power plant equipment has been installed as far as Tennant Creek and antennae have been hoisted into position and aligned between Mt Isa and Tennant Creek. The sophisticated radio equipment for the repeaters is now in all stations as far as Camooweal.

When the system is cut into service it will provide access to Australia's broadband system which extends from Port Hedland to Perth, across to Adelaide, on to Melbourne, Canberra, Sydney, Brisbane, Cairns, and from Townsville through to Mt Isa. The system will enable people to dial direct from Darwin to anywhere in these cities.

Although the system's capacity of 1,200 channels will not all be used immediately, it is capable of being expanded as the need arises so that good STD facilities may be maintained well into the future.

(Courtesy Australian Post Office News).

*Above shows the radio telephone station at Mt Isa. 43 towers like this span the 1,000 miles of desert and jungle between Mt Isa and Darwin. They are designed to function for long periods without human supervision.*


*The saucer shaped aluminium antennae for the Darwin-Isa link are delivered by truck and trailer as shown at left. Above is a view from atop one of the 250 ft high steel towers.*

# New techniques in superconductivity

Sixty years after its discovery, superconductivity is at last moving from being a scientific curiosity to one having far reaching practical applications. Engineering exploitation of the properties of superconducting materials seems likely to bring radical changes in the technology of electrical machines.

by DR R. HANCOX*

The phenomenon of superconductivity was discovered by the Dutch physicist, Heike Kamerlingh Onnes, in 1911, while investigating the electrical resistivity of metals at very low temperatures. His experiments with mercury produced a completely unforeseen result, since its resistance did not decrease smoothly as expected with falling temperature but dropped suddenly to nothing at a temperature of 4.1 degrees K (-269 degrees C).

Since then 24 metallic elements and more than 1000 alloys have been found to exhibit the same behaviour at temperatures ranging from 0.01 to 20 degrees K (-273.14 to -253 degrees C).

Rather surprisingly, most of the elements that exhibit this zero resistance, such as zinc, lead, and tin, are rather poor electrical conductors at room temperature whereas metals which are the best conductors at room temperature, such as copper, silver, and gold, do not become superconducting.

An obvious application of the phenomenon was in the construction of electro-magnets. Devices were visualised which would be capable of generating fields many times stronger than those with iron cores; at the same time, they would consume no power because the conductors used for the winding would have no resistance.

Unfortunately it was soon apparent that not only did a superconductor again become resistive above a well-defined critical temperature but the normal resistivity of the then known superconductors reappeared in relatively weak magnetic fields. It was not until nearly 40 years later, when the intermetallic compound niobium-tin was shown to be cabable of carrying high currents in a magnetic field of nearly 100 kilogauss, that superconducting magnets became a prospective reality.

Among the most useful superconducting materials now commercially available for constructing magnets are niobium-zirconium and niobium titanium, and compounds such as niobium-tin or vanadium-gallium. The former retain superconducting properties in magnetic fields up to 60 or 80 kilogauss, and the latter up to 160 or 200 kilogauss. Current densities in the superconductor up to 100,000 A / sq cm are common; very compact windings are therefore possible, so that a superconducting magnet is appreciably smaller than a water-cooled copper magnet producing the same field.

The major disadvantage of the superconducting magnet is that it must be operated at a very low temperature, surrounded by cryogenic insulation. In most cases it is convenient to operate the conductors in liquid helium at 4.2 degrees K (-296 degrees C), although operation at temperatures in the range 2 to 6 degrees K (-271 to -267 degrees C) is possible.

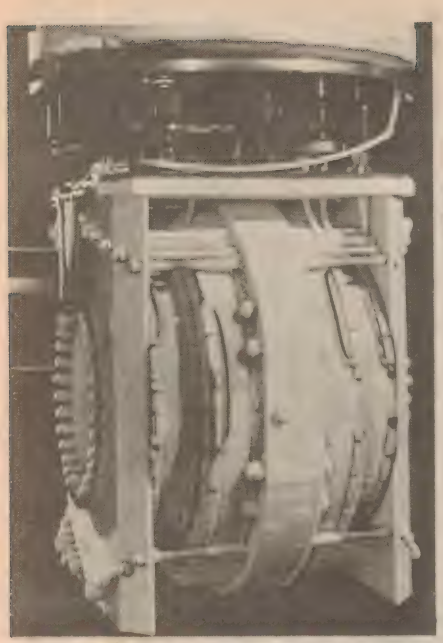
Often unpredictable and sudden transitions from superconduction to resistance at some point in the winding were a frequent occurence with early superconducting magnets. Because of the high current density in the superconductor, these "flux jumps" caused over-heating. Thus to protect the winding all present-day commercial superconductors, are composites which also include a good normal metal — such as copper or aluminium — to provide, temporarily, an alternative path for the current.

The addition of the copper also helps to stabilise the superconductor against unexpected transitions. Consequently, it is now practical to design a superconducting magnet which will behave in a reliable and predictable manner.

Composite conductors could be fabricated in many forms but only two are common — strip and multi-filament. Intermetallic compound superconductors are at present manufactured as thin strips because the material is extremely brittle and can be wound into a magnet only in that form. Layers of one-to-five microns thickness may be formed on a thin substrate of one of the constituent metals by a diffusion process (for example tin on to a niobium substrate to form niobium-tin), or, both constituents may be deposited simultaneously on to a steel substrate by vaporphase reactions. The copper for

*An 80 kilogauss superconducting magnet, wound from 12.7mm-wide niobium-tin strip.*

*Culham Laboratory, United Kingdom Atomic Energy Authority.



*Outer coils of an 80 kilogauss superconducting magnet. The coils are wound with multi-filament niobium-titanium composite and impregnated with resin.*

stabilisation and protection is then added, together with any steel required to raise mechanical strength, and electrical insulation provided to form a complete conductor.

Strip conductors can be wound into discs, any number of which can be stacked to form a solenoidal magnet. Joints between the discs are simply made by soldering together the ends of the composite conductors, and although such joints are slightly resistive the small local power loss is acceptable.

Many different magnets of this form have been built for laboratory use, since magnetic fields of 100 to 150 kilogauss can be obtained over a volume of a few cubic centimetres both conveniently and at relatively low cost. An equivalent water-cooled copper magnet would be much larger, would require around one megawatt of power to generate the field and also need an expensive cooling system to remove heat from the winding.

Alloy superconductors such as niobium-titanium are manufactured as composites with a large number of filaments of 5-250 microns diameter in a copper matrix. The overall size and shape of the conductor can be varied to suit the application, round wire being preferred for small magnets and a rectangular cross-section for larger systems. The multifilaments are twisted within the conductor to improve stability against transition to the resistive state, and for applications in which the magnetic field must change quickly it may be necessary to use filaments which are fully transposed to give good current sharing.

Where high overall current density or reliable performance are important in wire-wound magnets the winding may be impregnated with resin. One is required, of course, which will not crack when cooled to cryogenic temperature or when subjected to high-level mechanical forces.

Since the alloy superconductors are cheaper to manufacture and more flexible than the intermetallic compound types, they are more widely used — although only to

generate magnetic fields up to about 80 kilogauss. For higher fields it is possible to combine both types of conductor in order to utilise the advantages of each.

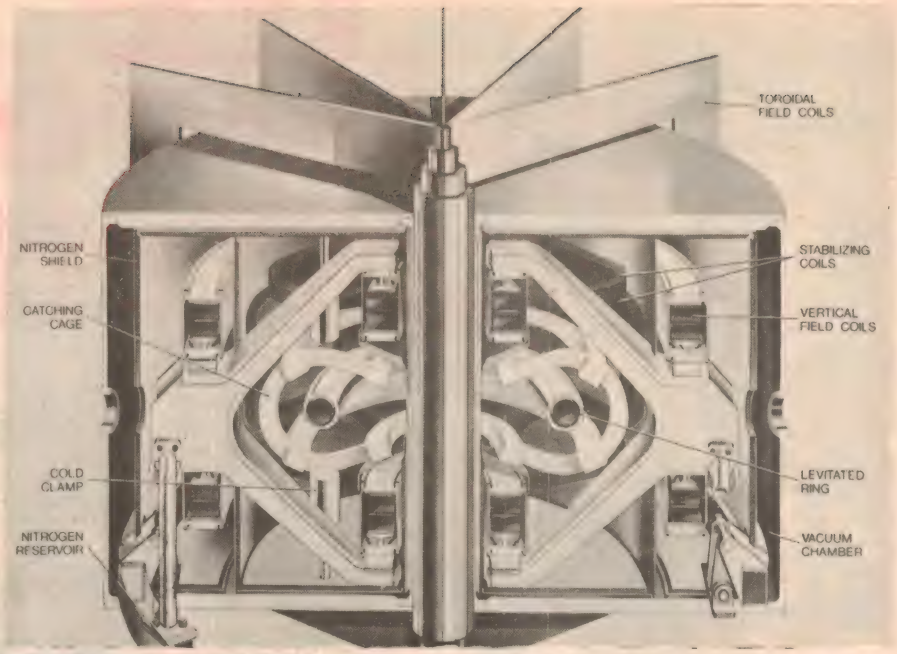
Apart from simple solenoidal or transverse field magnets there are several applications in which only superconductors can satisfy the required conditions. An example is the central ring of the superconducting Levitron experiment recently brought into operation at the Culham Laboratory of the United Kingdom Atomic Energy Authority for plasma physics research.

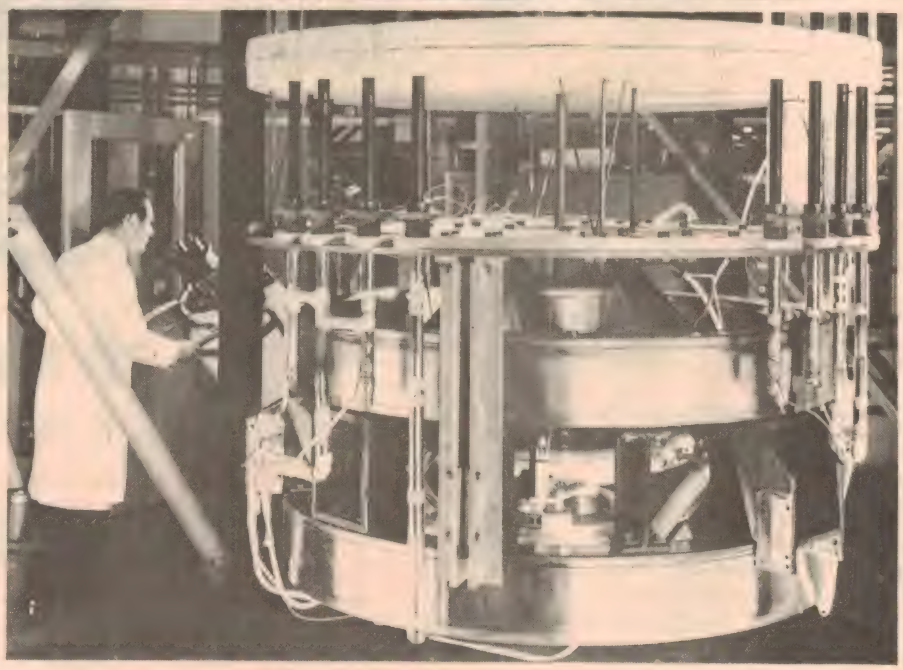
The basic requirement of this experiment was that a toroidal ring having a major diameter of 60 cm and a minor one of nine cm should carry a total current of 500,000 ampere-turns to provide part of the containing field for a high temperature plasma which completely surrounded the ring, but without any current leads or supports passing through the plasma. Since any currents induced in a normal resistive conductor would decay to zero in a fraction of a second it was only possible to conceive such an experiment by using a superconducting winding in the ring.

The decay of the current in such a superconducting ring is negligible, being due only to the very small resistance of the joints in the winding, and the current could persist for periods of a year or more. In the Levitron experiment this ring is then floated on the magnetic fields produced by several other superconducting windings, and maintained in position without mechanical support.

Understanding of the behaviour of superconducting materials and magnets has improved enormously and it is now possible to design large magnets with confidence. Already, magnets up to five metres in diameter are in use in high energy physics research, and preliminary work has begun on their industrial use as direct-current motors and generators.

Significant reductions in size and cost of alternators for generating electrical power have been predicted if superconductors are used in the field windings. The use of superconducting magnets for levitation of high-speed trains is also being considered. So at last, 60 years after its discovery, superconductivity is moving from being a scientific curiosity to having practical applications of considerable long term significance.



*At top is a cut-through view of the superconducting Levitron chamber in simplified diagrammatic form. Above are superconducting windings of the Levitron experiment at Culham Laboratory. The central ring is seen clamped in position for preliminary testing.*

# Organic superconductors discovered

A group of scientists at the University of Pennsylvania led by Alan J. Heeger and Anthony F. Garito has observed superconducting behaviour in a class of organic salts. In addition, the superconducting state was observed in these salts at temperatures three times higher than the highest known superconducting temperature of any other substance.

Experiments with the organic charge transfer salt tetrathiofulvalene-tetracyanoquinodimethan (TTF) (TCNQ) has revealed a narrow band superconductivity at a temperature of 60 degrees K. The highest superconducting temperature previously known, 20.4 degrees K, was for niobium-aluminium-germanium alloy. At temperatures lower than 60 degrees K the organic salt reverts back to the insulating state present at higher temperatures.

This behaviour, however, is not typical for (TTF) (TCNQ). Superconductivity has been observed in only three crystals out of approximately seventy which have been measured. These particular crystals had excellent morphology with exceptionally smooth faces. It would appear that rare microscopically perfect crystals of (TTF) (TCNQ) are required so that a superconducting state may be realised.

In an attempt to stabilize the superconducting state in organic salts Heeger and Garito synthesized the salt dimethyltetrathiofulvalene- tetracyanoquinodimethan (ATTF) (TCNQ). Despite considerable efforts over a three month period they have not yet been successful in obtaining single crystals of (ATTF) (TCNQ) of a size suitable for four-probe conductivity measurements.

To overcome this difficulty, an experimental technique (voltage-shorted compaction) for obtaining information from compacted samples was devised. In every case, the voltage-shorted compaction data showed a large and relatively narrow conductivity maximum centred around 50 degrees K.

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BA3012


# New Sperry Clock Display lowers the cost of electronic clocks!


This unique Sperry Clock Display not only helps cut engineering expense, reduce assembly time and lower component costs, it looks a lot better than other displays now on the market. This new unit, the SP-151, has the same bright, clear, continuous, easy-to-read characters that have made Sperry a major supplier of readouts in only two short years. It's ideal for eye appealing home and auto clocks of all kinds as well as a clock and / or frequency readout for radios and television sets.

And, the new displays are low in cost. Just $7.00 each in 1,000 unit quantities. That's less than $1.75 per digit. In large OEM quantities, the cost is under a $1.00 per digit. Interfacing with MOS / LSI clock chips, these planar gas discharge displays can be used in all dc or multiplexed applications, with or without blanking zeros. Character height is 0.50" with centerline spacing of 0.160". The display's face is only 1.593" x 1.120". Depth is just 0.255" plus 0.260" for the pins.

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## *State-of-the-art feature project:*

# LSI Digital Clock

by LEO SIMPSON

Here is the opportunity to build a state-of-the-art electronic digital clock, using a MOS LSI integrated circuit and a planar seven-segment neon readout with big, bright digits. Just to make the project more attractive, we have arranged for the major components to be available to readers as a kit, at a special low price.

The clock presented here uses the 50Hz mains both to power it and to supply its timing pulses. It has a four digit display to give conventional 12-hour readout. An extra two digits can easily be added if desired to give seconds readout. Its time accuracy will be the same as for a conventional electric clock but it has the advantage of digital readout, visibility in the dark and completely silent operation. In addition, it is an interesting conversation piece.

Over the past year or so, great interest has developed in electronic digital clocks. This has been mainly as a result of increased availability of more complex digital integrated circuits and their continually reducing prices. Even so, the clocks made from conventional TTL integrated circuits have been fairly complex and power consumption fairly heavy.

Two developments have dramatically changed the situation, by greatly increasing the circuit complexity attainable on a single silicon chip and at the same time dramatically reducing the power consumption for a given circuit function. The first is large-scale integration, which is the title applied to integrated circuits having more than 1000 devices per chip. The second is the advent of metal-oxide silicon (MOS) technology, which has reduced chip space requirements per function compared with bipolar techniques and also reduced power consumption.

The clock described here takes advantage of these new developments. It is designed around a single MM5314N digital clock chip developed by National Semiconductor. A great deal of flexible electronics has been incorporated into the 24-pin plastic dual in-line package of this device.

It contains all the required logic to display time in four or six digits, will accept an input of 50 or 60Hz, and will operate in 12 or 24 hour mode. Decoding for seven-segment displays is performed on the chip, as is "multiplexing" of digit and segment data. This is explained later in the article.

The clock readout is a Sperry gas discharge device designated SP-332. It works on the same principle as a conventional neon numerical indicator tube, except that unlike the normal indicator tube, it uses seven segments to form any digit from 0 to 9 — in the same way as seven-segment LED readouts. It has the advantage over most LED displays, however, in that its digits are 0.5in high.


*Two diecast boxes house this up to the minute clock which uses one LSI chip and a planar seven segment gas-discharge display.*

Now let us briefly describe the clock operation. First it has a divider-counter system similar in principle to the digital clock featured in June and August 1973 (File Nos 7 / CL / 10 and 7 / CL / 11). It takes half-wave rectified 50Hz, squares it up in a signal shaping circuit, and then divides it down to 1 pulse per second (1 pps). The 1pps signal is fed to a counter which cycles in BCD from 01:00:00 to 12:59:59 continuously (in 12 hour mode).

BCD output from the clock counter is decoded and multiplexed to drive the display via high-voltage PNP transistors.

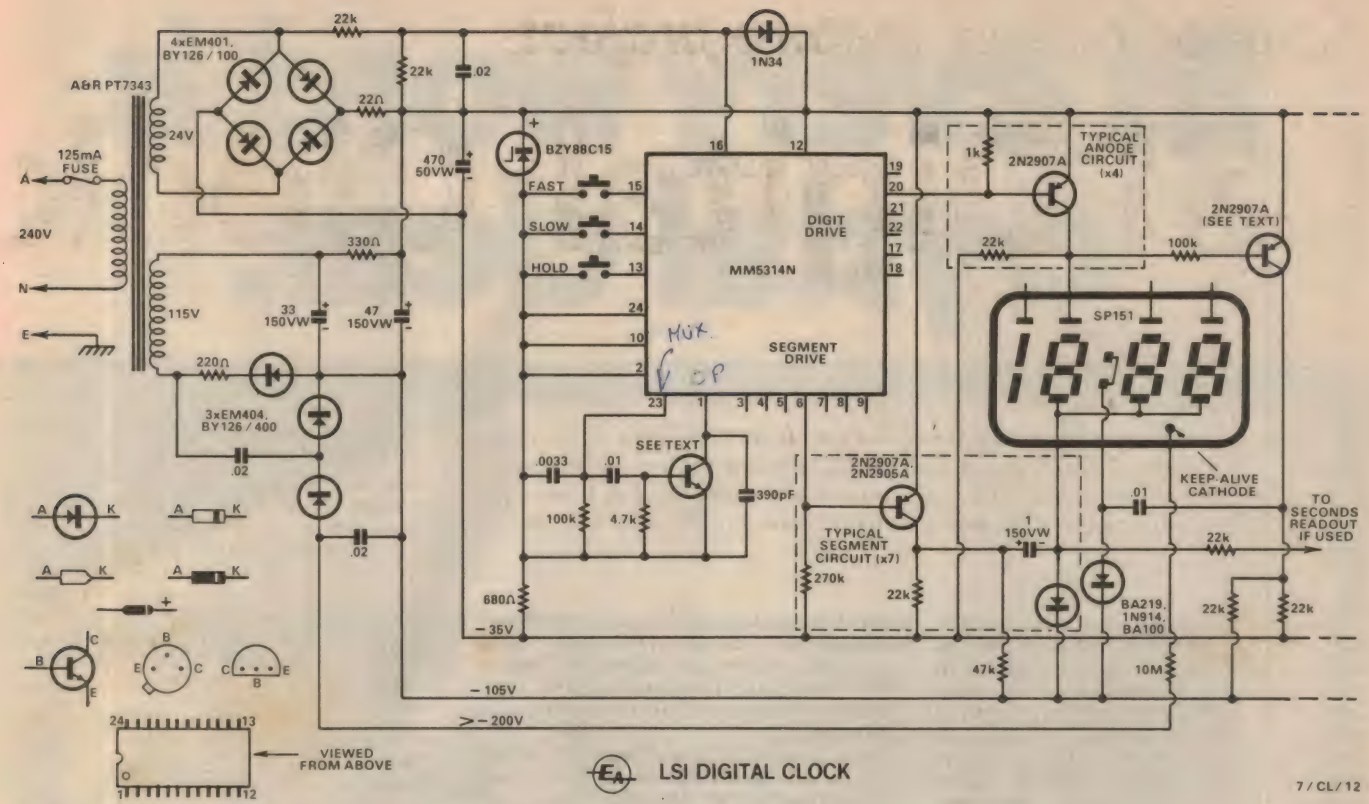
In simple terms, multiplexing is a method of simultaneously transmitting more than one piece of information via the one path. In the case of the clock described here, it is necessary to display up to six separate numbers simultaneously. Each number has up to seven segments and therefore requires seven items of information.

For a seven-segment display, eight separate lines are therefore required. Multiply this by six for a six-digit display, and we would need 48 lines, although when the clock operates in the 12-hour mode, the most significant digit is never larger than "1" and so will only need two segments; thus reducing the number of lines required to 43. If the clock chip used separate conventional seven-segment decoding for each digit, it would thus require 43 output connections plus all the input, supply and control connections. Rather an unwieldy package!

Multiplex operation gets around the problem by not attempting to show all digits continuously. Instead the digits are flashed sequentially, at a rate of about 1kHz; at this rapid rate, they all appear to be on continuously.

All equivalent segments of the various digits are tied to seven common lines, each driven by a PNP "segment driver" transistor. The anode of each digit is driven by a PNP "digit driver" transistor. Thus there are only eleven separate output connections (13 for a six-digit display).

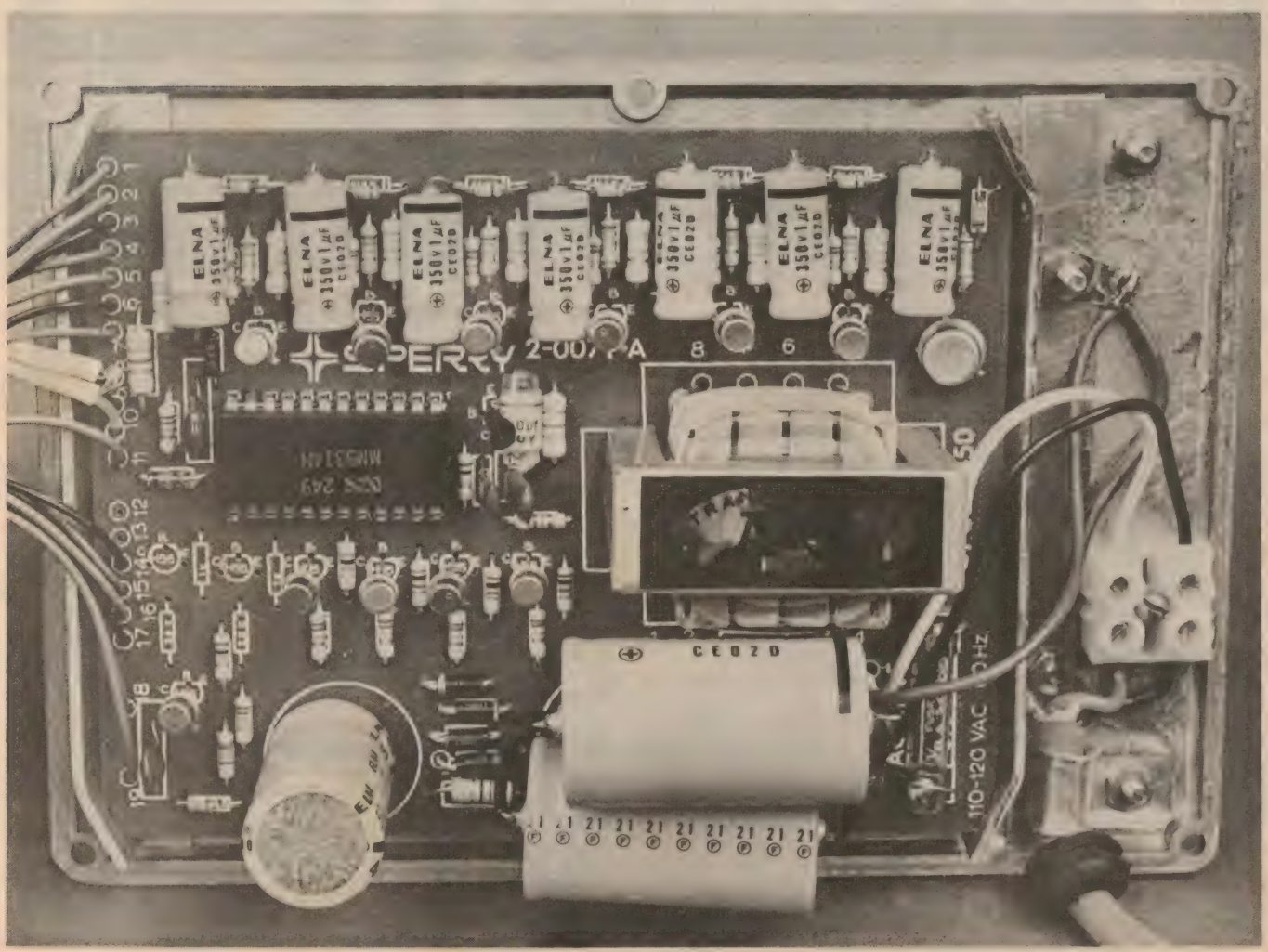
To display the various digits correctly, control signals are applied sequentially to the digit driver transistors, to apply anode voltage to each seven-segment readout in turn. At the same time the corresponding segment drive signals for each digit are applied to the common segment drivers. Each digit is thereby displayed at its appropriate position, but for only a fraction of the time: for four digit readout, one-quarter of the time, and for six digits, one-sixth of the time.




LSI DIGITAL CLOCK

7/CL/12

*Follow the text instructions carefully when assembling the clock.*



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ACI A.C.I. Electronics

ACE2780FP/R.

Thus we use a relatively complex electronic time-sharing technique to drastically reduce the number of lines necessary to display all the digits.

Three supply rails are provided for the clock operation and all are negative with respect to earth. A 35V rail powers the integrated circuit via a 15V zener diode stabliser, 105V is provided for the display and a 200V rail provided for the "keep alive" cathode of the display. This last function is self-explanatory — it keeps the display quiescently "alive" for operation at the rather low voltage of 105V and allows reliable multiplex switching.

The low voltage rail is provided by a conventional bridge rectifier, while a voltage-multiplier arrangement supplies the higher voltages from the 115V secondary winding of the transformer.

Having briefly described how the clock works, let us discuss where to obtain the parts. NS Electronics Ltd have imported a large number of kits of the major parts, and are making them available to readers at a special low price. The kits are available from the distributors of NS Electronics components, which are shown on a list published elsewhere in this issue. The kits are not available from NS Electronics Ltd.

Contained in the kit is the MM5314 IC, Sperry SP-332, connector kits for both these devices, the necessary transistors and two printed boards. The special offer price of the kit is an attractive $22.55 plus tax. The NS Electronics distributors will also be able to supply the special printed board mounting transformer from A&R, the bezel for the display and the components for the optional SECONDS display. They will also be able to supply additional replacement transistors, if the need arises.

Allowing for the special offer price of the kit plus all the other components needed to complete the clock, the all-up price is likely to be around $45 to $50.

Apart from the list of suppliers referred to earlier, other kitset suppliers should be able to supply the kits shortly after this issue goes on sale.

A special feature of the printed boards supplied with the kits is that they are fully coded and pre-tinned to make assembly easy.

Presentation of the clock in a suitable case or cabinet was a problem in that none of the currently available cases seemed really suitable. Readers skilled in carpentry or metalwork will doubtless come up with their own solutions, but we settled for the presentation shown in the photographs as it is relatively easy to duplicate.

Readers should note that while the circuitry is relatively easy to assemble, the finished unit will depend very much on the skill and patience expended on the physical form of the clock.

Our prototype uses two off-the-shelf diecast metal boxes, one standing upon the other. The larger of the two is inverted to become the base and the large printed board is mounted on the case lid. The smaller box is mounted upright so that its base becomes the front panel, with the lid used to support the readout board and the three time-setting switches.

Note that our method of presentation presupposes that the constructor uses the special printed-circuit mounting transformer from A&R, designated PT 7343.

Discussion of the construction procedure can start with the preparation of the diecast boxes and the associated hardware. The two boxes are attached together by two long screws passing through a shallow rectangular "tube". To make this, start with a piece of 16 SWG aluminium 18 x 1cm and bend it with the aid of a pair of electrician's pliers and a vice to form a rectangle approximately 7 x 4cm. The join should be in the centre of one of the long sides, and faces the back of the clock.

Next, with the aid of suitable coarse and fine files, bevel one of the sides of the tube to match the bevel on the sides of the smaller diecast box, so that when supported by it, it stands up straight. Be careful when bending and filing the aluminium, not to scratch the visible surfaces.

Having cut your teeth, so to speak, on the aluminium tube, the brackets for the printed board can now be made. These hold the board by its corners, in slotted holes. Notice that the brackets are bent differently. One has its mounting screws underneath the board, to save space on the lid. Follow the dimensions shown in the diagram carefully. Aluminium or steel may be used, but aluminium is easier to work. Use 18 SWG aluminium or thicker.

Now the cases may be marked and drilled. Two ⅛in holes are drilled on the major centre-line of the large case, space 5cm apart and equally spaced about the minor centre-line. Next, an elongated hole 1in by ½in is drilled and filed on the major centre-line between the two small holes, and displaced to the right of the case as far as possible so that it clears the power transformer. All the interconnecting wires pass through this hole, so make sure it is thoroughly de-burred. A matching set of holes is drilled in one side of the smaller case.

Mark, cut and drill the aluminium and elongate the appropriate holes with a rattail file. Cut slots with a hacksaw where necessary to enable the aluminium to be bent correctly. Bending can be done easily with the aid or a vyce and electrician's pliers. Note that the size of one of the board brackets is different from that shown in the prototype photograph.

All the holes may be drilled in the large lid using the printed board brackets as marking templates. File away the lip of the lid where the grommet and power cord are positioned, for clearance.

A 5/16in hole is drilled 15mm from the end of the larger case and 8mm from the edge, on the right-hand side looking from the rear. This is for the grommet. The hole is cut right to the edge with a round file or hacksaw so that the grommet slides in easily. This is to allow the lid to be completely detached from the base.

A hole measuring 5.8 x 2.9cm is cut in the base of the smaller box to take the

## COMPLETE PARTS LIST FOR CLOCK

*1 clock kit from NS Electronics distributors, comprising:*
*Sperry SP-151 12-hour clock display,*
*set of pin connectors for Sperry display,*
*National MM5314 integrated circuit,*
*integrated circuit socket connectors,*
*TO-92 transistor with green dot,*
*7x2N2907A or 2N2905A transistors (segment drivers),*
*4x2N2907A or MPS3645 transistors (anode drivers),*
*1x2N2905A transistor (colon driver) identified with a red dot,*
*2 printed wiring boards.*

*Additional parts required:*
*1 diecast box, 12x 9.5 x 3cm*
*1 diecast box, 17 x 12 x 5.5cm*
*1 Digibezel, part number 910-60*
*1 power transformer, printed board mounting, A&R PT 7343 or equivalent*
*2 SPST normally open, push-button switch*
*1 SPST normally open, push-button, slide or toggle switch*
*8 Silicon diodes, 1N914, BA100 or BA219*
*1 germanium diode, 1N34 or equivalent*
*4 silicon power diodes, EM401, BY126-100 or equivalent*
*3 silicon power diodes, EM404, BY126-400 or equivalent*
*1 zener diode, BZY88-C15 (15V, 400mW)*

*RESISTORS*
*(¼watt, 10 pc tolerance unless otherwise noted)*
*1 x 10 megohm, 7 x 270k, 2 x 100k, 7 x 47k, 15 x 22k,*
*1 x 4.7k, 4 x 1k, 1 x 680 ohm ½W 1 x 330 ohm ½W 5 pc tol, 1 x 220 ohm ½W 5 pc tol, 1 x 22 ohm ½W.*

*CAPACITORS*
*1 x 470uF 50VW printed board electrolytic*
*1 x 47uF 150VW electrolytic*
*1 x 33uF 150VW electrolytic*
*7 x 1uF 150VW electrolytic or metallised polyester*
*3 x .02uF 100VW metallised polyester*
*2 x .01uF 100VW metallised polyester*
*1 x .0033uF 100VW metallised polyester*
*1 x 390pF 100VW polystyrene or ceramic*

*(Additional parts for optional SECONDS readout)*
*1 Sperry SP-151 display*
*1 set of pin connectors for Sperry display*
*2 x 2N2907A or MPS3645 transistors (anode drivers)*
*1 x 10M ¼W, 9 x 22k ¼W, 2 x 1k ¼W (all 10 pc tol)*
*1. Digibezel kit to suit longer display.*

*MISCELLANEOUS*
*Aluminium channel to attach cases, printed board mounting brackets (see diagrams and text) mains cord and plug, grommet, cord clamp, two-way terminal block, solder lug spaghetti sleeving, 4 rubber feet, ⅛A fuse, figure-8 shielded cable, hook-up wire, screws, nuts, washers, lock-washers, solder, can of suitable spray paint.*

*NOTE: Components listed here are those for the original design. Semiconductors should not be substituted unless they are direct equivalents. Passive components with higher ratings may be used in some cases provided space is not a problem (see text).*

# PURE SOUND
# SONY STYLE!

New Ferrite heads. Up to *200* times longer wear. All three heads—erase, playback and record on this superb new Sony Slant front stereo tape deck TC-377 provide extremely long life and remarkably *improved* performance to meet the requirements of the most demanding audiophile. These new Ferrite heads give fully extended frequency response (20-25,000 Hz) and outstanding signal-to-noise ratio.

With so *many* functional and satisfying features, the Sony TC-377 maintains its superior characteristics for years!

And ears. Like yours.

*Can also be used in the horizontal position with a change of mounting.


TC-377

With the TA-1150 Sony provides tomorrow's amplifier today—more "pure" power (30W RMS per channel) even in sub-sonic and supersonic frequencies, distortion below the measuring capability of ordinary instruments, wider dynamic range, good transient response, four-channel stereo adaptability, input and output facilities for two tape recorders, etc. No engineering effort has been spared in developing the new TA-1150 integrated amplifier. It incorporates new technology including low noise linear integrated circuit especially designed for pre-amplification, paralleled true-complementary push-pull power amplifier stage which eliminates the big DC blooking capacitor for speaker termination and provides better low frequency response, high damping factor and low distortion even at sub-sonic and supersonic region. The TAC-1N walnut finish wooden cabinet is available as an optional accessory.


TA-1150

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SN142

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Please send me ..... kits for the "Electronics Australia" LSI Digital Clock, at the special low price of $28.75 ($22.55 plus sales tax) per kit. Enclosed is a cheque or money order for $29.25 which includes packing and postage.

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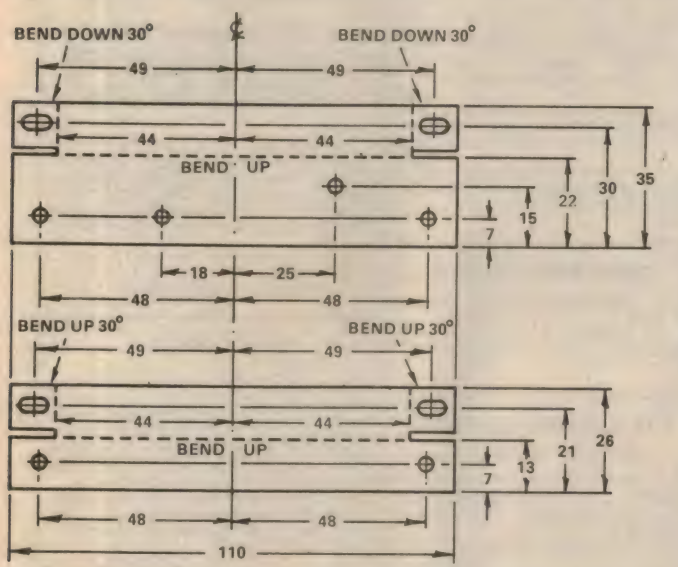
Send this coupon together with your remittance, or take it in person to the following NS Electronics distributors:

VICTORIA: Radio Parts Group, 562 Spencer St, West Melbourne.
NSW: Pre-Pak Electronics, 718 Parramatta Rd, Croydon.
SA: NS Electronics Pty Ltd, 51 Wood Ave, Ridleyton.
WA: W.G. Moncrief Pty Ltd, Box 6057, Hay St East P.O. Perth
TASMANIA: Medhurst Wholesale Ltd, 95 Argyle St, Hobart.




ALL DIMENSIONS IN MILLIMETRES

*Two brackets are needed to mount the main printed circuit board. Make them of aluminium for ease of working.*

Digibezel, which is centred on the panel. It is best drilled roughly out and then brought out to size by filing. Three ¼in holes with centres 15mm apart and 15mm from the lower edge are also drilled on the lid for the time-setting switches.

The readout board is mounted by two ⅛in screws, nuts and washers through the holes originally provided on the board for the HOLD and SLOW time-setting switches. We elected to have the switches on the rear panel because they would be both unsightly on the front panel, and an invitation to knob-twiddlers! Using ⅛in screws with flat washers in the large board holes allows sideways adjustment of the board to position the display precisely behind the Digibezel. The corresponding holes (⅛in) are drilled and countersunk with centres 8.2cm apart and 3cm from the top edge of the lid. The left-hand hole is centred 1cm from the edge of the lid.

Having drilled and de-burred all the holes in the cases, use a heavy wire brush to remove all the burrs, file-marks and swarf from the cases. If you have an electric drill and a circular wire brush, so much the better. It pays to carefully select the cases when purchasing them to be as free of imperfections as possible.

Now attach the cases with ⅛in screws and nuts and screw them up tightly. Attach the lids also, in preparation for painting. Use a well ventilated place, and make sure the work is dust and grease free. Follow the paint manufacturers' instructions carefully. Give the unit a coat of etch primer and then as many coats as necessary of the finish coat.

*(Continued next month)*

# Digital logic trainers: another design approach

Here are details of a digital logic trainer which has been developed by an engineer in Victoria. While basically having much in common with our own unit described a few months ago, it offers a number of additional features. A novel construction approach should significantly reduce the time and effort needed for assembly.

by JAMIESON ROWE

Shortly before we completed our "Digital Logic Trainer Mk 2", which was described in the March and April issues, we learned that by sheer coincidence a similar unit was also nearing completion in the Computer Systems Division of Fairchild Australia Pty Ltd, in Croydon, Victoria. Its designer was electronics engineer Mr Roger McGlinn, then working in the division but now with Datatronics Pty Ltd, a computer systems firm in Box Hill.

Naturally we were very keen to see Mr McGlinn's trainer, to compare his approach with our own. There haven't been very many logic trainer designs to appear in recent years, and in such a situation one likes to be able to compare notes with someone else, to gauge whether one's thinking is along the right general lines. The fact that the designer of the trainer was a computer systems specialist gave it added weight as a reference for comparison.

In response to our request, Mr McGlinn very kindly sent details of his trainer. He went further than this, in fact, sending us in addition a completed trainer so that we could look it over, put it through its paces and take the photographs shown on these pages.

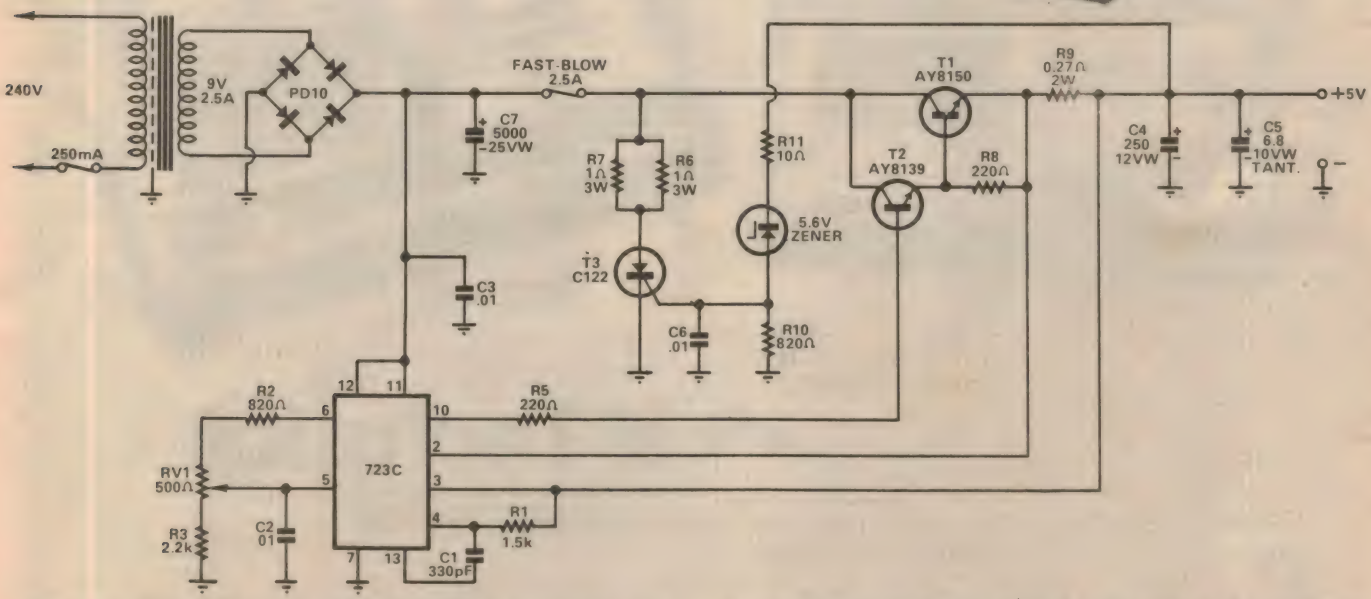
He explained that his trainer, which he has called the "Digi-Lab", was basically the outcome of considerable pressure exerted by his eldest son. Hearing frequently of dad's achievements with computers, his son understandably wanted to have a "computer" of his own. A logic trainer was the obvious (logical?) choice, combining immediate appeal with long-term educational value.

One of the first things which struck us when we took the Digi-Lab out of its shipping carton was the basic similarities between it and our own design. There are differences, of course, and many of these only became apparent when we examined the unit in more detail. But despite the differences, the designs have much in common.

A good example of this is the interconnection scheme used. When we were developing our own unit, we spent considerable time looking at the various types of plug and socket systems available. One after another they were rejected, not because they were in any way inferior as reliable connectors, but generally because they were either too large physically or too costly. For a device like a logic trainer, it is essential for the patching connectors to be both small and low in cost, because there are so many used.

After much frustration, we finally discovered that McMurdo Australia were marketing kits of low-cost interconnecting leads, designed originally for their IC breadboard reviewed last month. The

*The Digi-Lab trainer, which was developed by Victorian computer systems engineer Roger McGlinn at almost exactly the same time as our own trainer. It offers a number of novel features.*




*The power supply used in the Digi-Lab, which is somewhat more elaborate than than in our own unit. It will deliver up to 2A with excellent regulation, sufficient to power a number of extender units as well as the basic trainer. Note the SCR used as an overvoltage crowbar. Its function is to shut down the supply if the output voltage rises beyond a safe level.*

# You don't need another lecture on Dolby

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WTGD13N

breadboard uses pins attached directly to the printed wiring board, and the leads are provided with sleeved clips very similar to those in miniature valve sockets. We found that the clips would also mate with the small pin used by McMurdo in their miniature feed-through type FT-1, to provide a reliable and very compact interconnection scheme — and one which costs about half that of of other systems.

Believe it or not, Roger McGlinn's trainer uses virtually the same interconnection system! He too, had looked into the other possibilities, and had finally hit upon the McMurdo connector leads at almost the identical time as ourselves. The only difference is that instead of the feedthroughs, he has used the same pins used by McMurdo themselves; this is because of the different construction approach, which I will describe in a moment.

Another close similarity between the two designs is that, like ourselves, Roger McGlinn has chosen to provide his trainer with only the basic logic elements — gates, flip-flops and inverters, together with indicator LEDs, switches and push-button pulsers, and an adjustable clock oscillator. There are minor differences in the numbers of each element provided, and in terms of the ways in which the clock oscillator and pulsers have been implemented, but all things considered the two are remarkably alike.

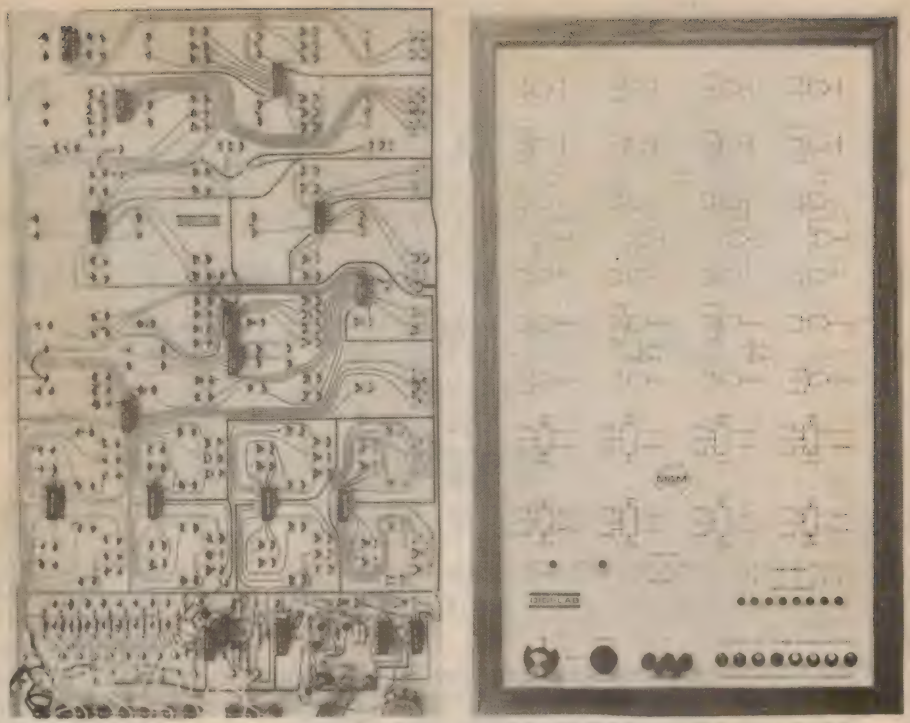
Needless to say, these basic similarities between the two designs have been reassuring. When one is basically only an electronics "GP", dabbling in a specialised field, it is nice to know that one's basic thinking agrees reasonably well with a specialist!

But now for the differences between the two units, which will probably be the main source of interest as far as you, the reader are concerned.

Undoubtedly the main difference between the two is in terms of the physical construction. Roger McGlinn has chosen to base the whole unit on a large printed wiring board, which actually forms the front panel of the trainer. The ICs and other components mount directly to the copper tracks on the rear of the board, while the front of the board is silk-screened with acrylic paint to show the various logic symbols and control labels. The connector pins simply pass through the board and solder directly to the copper tracks at the rear.

Without a doubt, this makes the Digi-Lab very much easier to put together than our own trainer. One is not faced with the prospect of carefully cementing some 226 feedthroughs into holes in the front panel, nor does one then have to solder in about 100-odd lengths of hookup wire between the feedthrough pins and the IC mounting board! The ICs and other components mount directly on the board-cum-panel, and the copper pattern makes all the internal interconnections except a few minor links, etc.

You don't get very much for nothing in this world, of course, so that inevitably these advantages must be paid for. The printed wiring board is quite large — approximately 260 x 410 mm (10 x 16in) — and as such it is somewhat beyond the range of



*At right is a view of the front panel of the Digi-Lab, with the rear of the printed board to the left. It performs virtually all of the internal panel connections.*

board sizes handled by most manufacturers. As a result it tends to pose something of a supply problem, and to be rather expensive.

It was from consideration of the probable supply problems and high cost associated with a large printed board that we ourselves elected to follow the alternative approach. And we are still inclined to believe that for a hobbyist, who is presumably building up a trainer at least partly for enjoyment, it is better to expend time and tedium rather than cash. However not all trainers will be built by hobbyists; large numbers are built up by technical colleges and similar organisations, who understandably have less time to spare.

The McGlinn Digi-Lab should therefore be of considerable interest to such organisations on this point alone. In fact it would be the obvious choice wherever it is desired to build up one or more trainers as rapidly as possible, with cost of less concern.

As may be seen from the photographs, the Digi-Lab printed board is mounted into a sloping-sided box, which is made from veneered particle board. The power transformer and other bulky power supply components are mounted on the metal bottom of the case, and therefore do not place any strain on the printed board.

Probably the most significant electrical difference between the Dig-Lab and our own trainer is that Roger McGlinn has used a more elaborate power supply. Instead of the simple rectifier and single-IC regulator arrangement we used, he has used a more elaborate circuit based on a Fairchild uA723C precision voltage regulator, which drives a power Darlington configuration using AY8139 and AY8150 transistors.

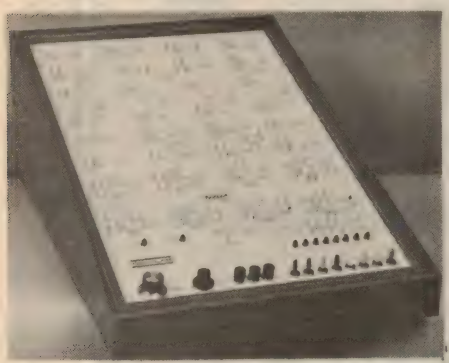
The supply is designed to deliver an output of up to 2 amps with negligible ripple and noise and a regulation of 0.2pc. This is considerably more than is required by the basic trainer, but has allowed Roger McGlinn to provide for the use of "extender units", to expand its logic facilities.

The circuit of the supply is shown, as we thought readers might be interested in it not only as a trainer supply, but as a general-

purpose logic supply. As may be seen, it incorporates current limiting (by means of the 0.27 ohm sensing resistor R9), and an SCR "crowbar" circuit for overvoltage protection. This makes it very reliable for use with almost any type of logic system.

The output voltage level is adjusted by RV1. The heatsink required by the series pass transistor can be conveniently made from a 3-inch length of 1.25 x 1.25 x 0.125 in aluminium angle, or a small board-mounting commercial heatsink of similar area.

The function of the crowbar circuit is to turn the regulator circuit off smartly if the nominal 5V output supply line should rise in level as a result of potentially damaging switching transients, or a fault path from a higher voltage supply. As soon as the voltage rises, the zener diode in series with R11 conducts, firing the SCR. This immediately blows the fuse in series with the rectifier output, shutting down the supply before serious damage can occur.



*Another view of the Digi-Lab. The unit shown is the version of the original design being marketed by M & M Electronics, of Kilsyth, Victoria, selling for $198 complete.*

The SCR must draw heavy current — around 30 amps — for about 10 milliseconds in order to blow the fuse rapidly. The wiring in the SCR anode-cathode circuit (including the earth return back to C7) must therefore be capable of carrying this order of current. If the supply is built up on a printed wiring board, the conductors concerned should be at least 7mm wide.

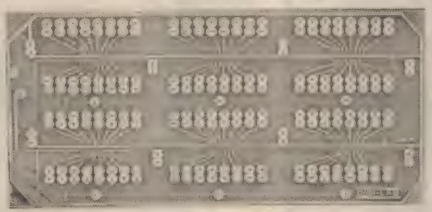
There are other electrical differences between the Digi-Lab and our own trainer, but these are of a more subtle nature. Roger McGlinn has provided a two-phase clock circuit, for example, with LED indicators fitted to both outputs to allow visual monitoring at low speeds. The two clock signals are produced in quite a straightforward way, by using the output of the basic clock oscillator circuit to trigger a toggling flip-flop. The actual clock outputs are then taken from the Q and Q-bar outputs of the flip-flop.

The Digi-Lab is provided with three push-button pulsers, but these use somewhat different circuitry from the two in our own trainer. Instead of R-S flip-flops which suppress contact bounce and produce pulses of a length equal to the time the buttons are pressed, there are R-C filters for bounce integration, followed by one-shot monostable multivibrators. These are based on the Fairchild 9602 dual monostable device, and deliver a single relatively short pulse of fixed length each time a button is pressed. There are two 9602 devices used, and the fourth monostable element is used for conditioning of an external pulse input.

As mentioned before, the Digi-Lab provides different numbers of logic elements to those of our own. There are eight J-K flip-flops, each of which is provided with inputs for direct setting as well as direct resetting. Similarly there are six 2-input gates, six 3-input gates, four 4-input gates, four inverters, and four AND / NOR gates. There are also eight LED logic level indicators, and eight level setting switches.

There are "high" and "low" fixed logic level outputs, the former being derived from the 5V supply line via dividers. This provides greater safety when logic element inputs must be tied to logical high, particularly when extender boards are used.

As shown in the photograph, the extender



*An extender board for the Digi-Lab. It provides for up to six 14 or 16-pin IC sockets, with power supply bus lines.*

board designed for use with the Digi-Lab is basically a printed board with provision for mounting up to six 16-pin DIL sockets. Provision is made for all socket clips to be brought out to isolated patch pins, with supply pins adjacent to each socket. This does not commit any socket to a particular configuration of supply pins, but allows the sockets to be set up for any desired device — whether of 8, 14 or 16 pins.

Using one or more extender boards, with power derived from the basic Digi-Lab, it is therefore possible to connect up quite elaborate systems, which may include a variety of MSI devices as well as those of single function.

The foregoing details of the Digi-Lab should give a good idea of its capabilities, and also its features and possible drawbacks compared with our own unit. No doubt there will be some readers who will find both units less than ideal for their purposes, just as there will be others who will see a clear advantage in either one or the other. Hopefully the details we have given of the McGlinn design may enable the former people to put together a hybrid unit combining the features of both!

Those who are keen to build up or acquire one of the Digi-Lab units will no doubt be interested to learn that the design is being marketed in both kit and completed trainer form by M & M Electronics Pty Ltd, of 18 Shelley Ave, Kilsyth, Victoria 3137 (phone 725 8766). Quoted price of a basic Digi-Lab kit, which does not include the cabinet, switches, or power transformer, is $130. A completely wired unit costs $198, while an extender unit with six ejecting-type 16-pin DIL sockets is $82.

# Crystal-locked converters for the HF and VHF bands

Continuing the current series of articles on simple solid state receiving converters, this article gives details of crystal-locked designs for both HF and VHF reception. All the basic information is given, to allow you to "roll your own" converter for any desired frequency.

by IAN POGSON

So far, we have described converters in this series beginning at 2MHz and continuing well into the VHF region, in articles which appeared in April, June and August, 1973. All of the converters described to date have used a self-excited local oscillator. We now move on to a somewhat different concept, still using the same printed board but instead of a tunable oscillator, a crystal oscillator will be used. This means of course, that the oscillator will be on a fixed frequency.

The move to the concept of a "crystal locked" converter has many ramifications and we cannot hope to cover them all. However, we propose to start with the basic concepts relating to the HF range — 3 to 30MHz. Later on, we will have a look at the lower end of the VHF range.

As may be seen from the previous articles, the use of a self-excited local oscillator allows the converter oscillator to be made variable, that an incoming signal anywhere within a range may be converted to a fixed first intermediate frequency. This is the simplest way of tuning a range of frequencies. One disadvantage of this system is that the frequency stability of a self-excited oscillator deteriorates as the frequency is increased. Where this is important, the problem may be considerably reduced by using a crystal oscillator and using the "tunable IF" technique. This is just mentioned in passing, as we will not be able to go into this aspect in any detail.

Where only one frequency, as opposed to a band of frequencies, is all that is needed, then a fixed frequency local oscillator is indicated. The oscillator may still be self-excited, but much greater frequency stability may be achieved with a crystal oscillator. Apart from the reduced need to re-adjust tuning, there is also the important point that where a fixed tuned converter is concerned, if the local oscillator is not stable enough, it is possible for the wanted signal to drift out of the passband of the receiving system. For this reason, the crystal locked converter is very desirable.

By its very nature, a fixed tuned, crystal locked converter must be tailored to suit each individual need. It would be an impossible task to foresee all the possibilities and comment on them. Rather, we show the basic circuit and sufficient information will be given so that a unit can be made up to suit any desired purpose.

Two important parameters which determine the design of such a converter are the frequency to which it is to tune and the frequency to which the incoming signal is to be changed. A couple of examples should make this point clear.

Let us assume that we wish to receive a signal on 2.55MHz and that we have a broadcast receiver into which we can feed the converter. We will also assume that we are far enough away from any station on or very near to 1.6MHz to allow us to use this as our first IF. The local oscillator (crystal) frequency may be on either the sum or the difference of the two frequencies just mentioned, however at these low frequencies, we should choose the sum frequency, which comes to 4.15MHz. (If we had chosen a first IF of 3.5MHz instead of 1.6MHz, then the crystal frequency would come to 6.05MHz.)

For our second example, we will suppose that 15.11MHz is the wanted frequency, and the first IF again 1.6MHz. As a higher frequency is involved, it is more feasible to use the difference as well as the sum for the frequency of the local oscillator. The sum will be 16.71MHz and the difference will be 13.51MHz. It is generally considered better practice to 'choose the sum frequency, unless there is a good reason for using the difference. We may touch on this point later on, when dealing with oscillators for the VHF range.

Continuing with this example, 1.6MHz is not a good choice as a first IF for frequencies as high as 15MHz, as it becomes difficult to avoid "image" problems. A higher frequency would be better, such as 3.5MHz. This gives us a sum frequency of 18.61MHz and a difference frequency of 11.71MHz.

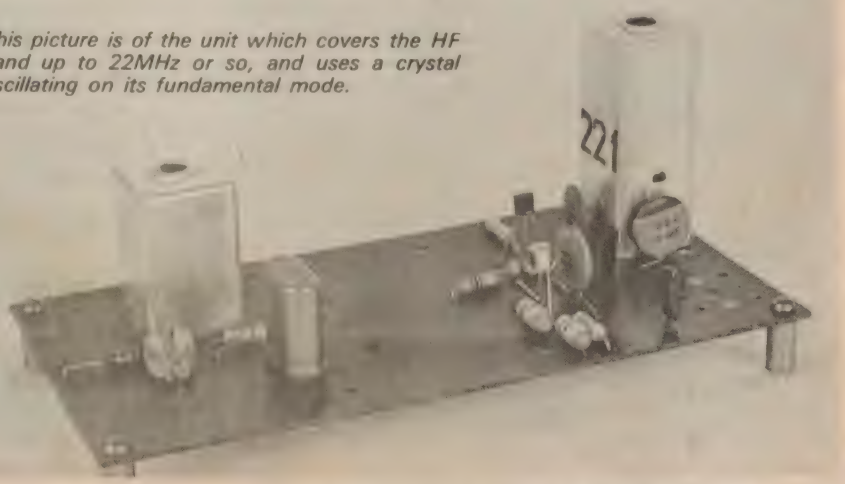
The choice of a first intermediate frequency will be dependent upon a number of considerations. It is not possible to be too dogmatic but from a technical point of view, it is wise to keep the ratio of the incoming signal to the first IF to no more than about 5 to 1. Taken literally, this would mean that if we have to consider signals up to 8MHz or so, we could use a first IF of 1.6MHz. For a first IF of 3.5MHz, we could go to about 18MHz, and so on.

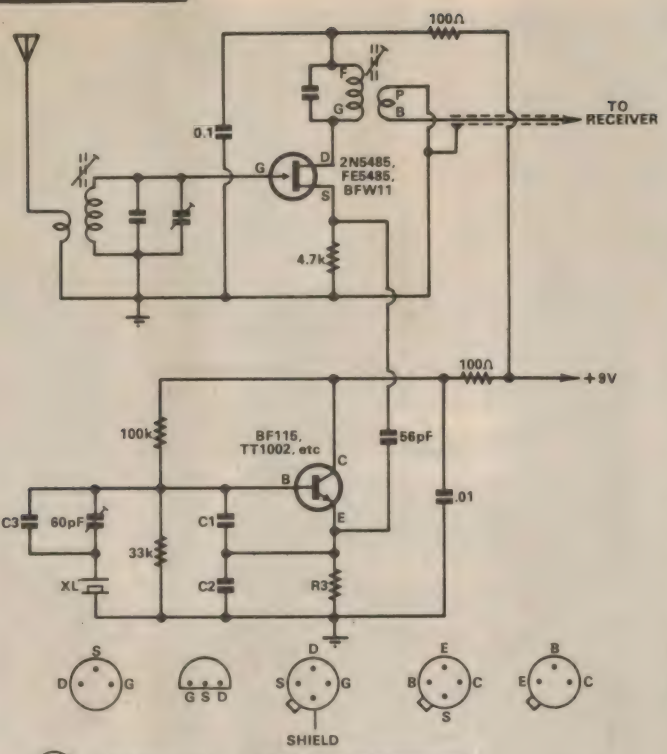
Provided we have a receiver which will tune to a first IF in accordance with the

## PARTS LIST

*1 Printed board, 6in x 3in, 73 / 3c*
*1 Aerial coil, RCS type 221 (see text)*
*1 Neosid coil former, 7.6mm x 2½in with slug & can (see text)*
*1 Neosid coil former, 7.6mm x 1⅜in with slug & can (see text)*
*1 Transistor, 2N5485, FE5485, MP-F106, BFW11*
*1 Transistor, BF115, TT1002, or similar*
*6 Spacers, ½in long x ¼in diameter, tapped ⅛in Whitworth*
*1 Crystal (see text)*
*1 Crystal socket to suit crystal*
*RESISTORS (½W)*
*Resistors should be chosen to suit individual requirements by reference to the text and tables, together with the relevant circuitry.*
*CAPACITORS*
*Capacitors should be chosen to suit individual requirements by reference to the text and tables, together with the relevant circuitry.*
*MISCELLANEOUS*
*Hookup wire, 2ft coax cable, solder, screws, nuts.*

*This picture is of the unit which covers the HF band up to 22MHz or so, and uses a crystal oscillating on its fundamental mode.*






*The basic circuit for the crystal locked converter; the oscillator shown is for crystals oscillating on the fundamental mode up to 22MHz or so. The table below should be consulted for constants appropriate to the frequency.*

**HF CRYSTAL LOCKED CONVERTER**

3/CV/12

| F (MHz) | R3 | C1 | C2 | C3 |
|---|---|---|---|---|
| 0.95-3 | 3.3k | 220pF | 220pF | 680pF for 50pF crystals * Not required for 30pF crystals * |
| 3-6 | 3.3k | 150pF | 150pF) | 120pF for 50pF Crystals * |
| 6-10 | 2.2k | 150pF | 150pF) | 33pF for 30pF Crystals * |
| 10-18 | 1.2k | 100pF | 100pF) | Not required. 20pF crystals * |
| 18-21 | 680 ohms | 68pF | 33pF) | only for these ranges |

NOTE: The terms "20, 30 and 50pF crystals" refer to the capacitance load used when these crystals are measured in standard test sets, and is not related to any static capacitance present within the crystal unit itself.

above, then so much the better. However, we may be restricted by the tuning range of the receiver and so we will have to compromise.

Another factor may help to determine the first IF: if we happen to have a crystal on hand, its frequency may well determine the first IF!

The basic circuit of the converter is shown and it should be referred to when working out the details of the converter to suit your particular needs. The variables associated with the mixer are the output transformer and the tuned circuit set to the wanted frequency. We have already given details of suitable coils and transformers in our earlier converters of this series. Later in the article, we will give a table and more details of these coils. Of necessity they only cover some specific bands and frequencies, so that if you wish to use some other frequencies, then the table will be useful as a guide only.

The crystal oscillator circuit is also given but certain component values have to be decided by the actual crystal frequency being used. Once this is decided, the values of the coded components may be obtained from the table. As an example, suppose that we need a crystal on 12.5MHz. Reference to the table reveals that R3 is 1.2k, C1 and C2 are both 100pF and C3 will be 33pF for the common 30pF crystal. The capacitance for which the crystal was ground must be taken into consideration and the details are given in the table.

From a constructional point of view, this version of the converters is perhaps the simplest yet, as shown by the picture and component layout. At the same time, the units we are presenting here must of necessity be typical examples only. More than likely, your particular version will deviate from these at certain points, so that care will be called for.

When photographed, the HF unit was fitted with a crystal on 12.5733MHz and an output transformer set to 1.6MHz. This means that the converter may receive signals on either 14.1733MHz or 10.9733MHz. The tuned circuit into the gate of the FET may be set to either of these frequencies, simply by adding the correct amount of capacitance across the coil. The coil as fitted is the one used originally in the first converter which was tunable from 6 to 19MHz. Before leaving the photographs, we should mention that an unwanted capacitor was left on the board at the time of photography. It is the small plastic capacitor near the corner of the output transformer, which should be disregarded.

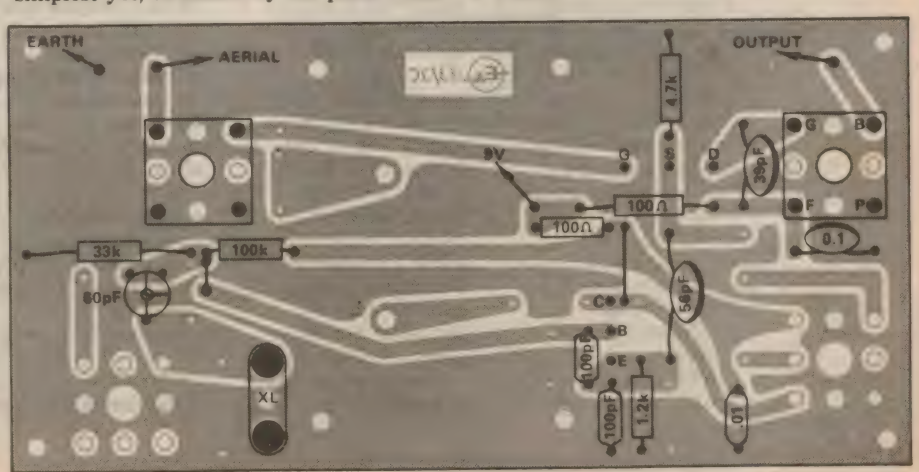
Readers who wish to venture into the lower part of the VHF region may also do so with this little converter. Those of you who wish to set up on the HF band where circumstances call for a crystal oscillator above about 21MHz, will in any case have to go to a crystal oscillator where the crystal is made to oscillate not on its fundamental, but on its third overtone. In either event, some changes in the circuit will be necessary.

Where interest lies in the upper HF region, we suggest that you use the third overtone crystal oscillator as shown in the circuit and table. The coupling capacitor from the emitter of the oscillator to the source of the mixer may be between 33pF and 56pF. However, for those interested in the lower VHF region, the coupling capacitor is reduced to only 1pF, and is taken from the emitter of the oscillator, to the gate of the mixer and not the source. The 4.7k resistor in the mixer source is then bypassed with a .01uF ceramic capacitor. These details are shown abbreviated on the third overtone oscillator circuit diagram.

A small coil is needed in the third overtone oscillator circuit and details are given in the table. These should be carefully followed, according to the actual crystal frequency to be used.

In the prototype, we have tried a third

*Below: a typical layout of components seen from the component side. The copper is shown "ghosted", making it relatively easy to follow the circuit. Actual board size is 6 x 3 inches.*



overtone crystal on 43.125MHz and the whole unit performs very well. Using a first IF of 3.5MHz, we are able to tune the converter to either 46.625MHz or 39.625MHz. With the converter fed into the EA130 Tunable IF receiver, the sensitivity of the whole setup is such that signals are detectable down to about 2uV.

Third overtone crystals are readily available up to about 63MHz. Assuming a first IF of 3.5MHz, this means that signals may be tuned up to about 66.5MHz. Readers who wish to go higher than this will be interested in the fifth overtone crystal oscillator. Details of a suitable circuit are given, along with coil winding data.

Fifth overtone crystals are normally available up to about 105MHz. This means that the upper limit of the frequency to which this system may be tuned is 105MHz plus the first IF. It is worth remembering that earlier we mentioned that as we go higher in frequency, it is advisable to increase the first IF. By taking the IF high enough, the aviation frequencies up to 136MHz could be covered.

We have not tried the fifth overtone circuit but its source is very reliable and we give it with full details so that readers who are interested may come up with a converter to meet the particular need. The printed board will accommodate the variations involved in both the third and fifth overtone oscillators.

To make up the circuit of your choice, it will be necessary to study the foregoing, along with tables, circuits and coil details. Where coil details are not given for the wanted frequency, then it will be necessary to interpolate from the information given. Having arrived at the input coil to use, it must be tuned with the correct amount of capacitance. This may be either a lumped value, tuned to resonance by the slug in the coil, or a smaller value with trimmer added to make the final adjustment. The capacitors may be added underneath the board and immediately across the coil.

The board provides for the fitting of a socket to take the type HC6/U crystal holder. If you wish to use a crystal requiring a different socket, then appropriate changes will have to be made.

When ordering the crystal, certain details must be given. A couple of examples may help. If a crystal is wanted for this project and where the frequency is not over 21MHz, then its specification would go something like this: 3656kHz, .005pc, ambient temperature, 30pF, HC6/U. Where the frequency is above 21MHz and not over 63MHz, it could be: 46.33MHz, .005pc, third overtone, ambient temperature, HC6/U. For crystal frequencies above 63MHz and up to 105MHz, the fifth overtone will be called for.

When it comes to actually making the converter, perhaps a good place to start would be with the coils which are needed. The aerial coil will have to tune to the frequency of the wanted signal and details may be obtained from the table. If the coil is wound with a heavy gauge of wire, it may be wound first on a drill or other rod of the required diameter. The length of winding is then adjusted by gently stretching, where this is required. A tapping point must also be provided by scraping a little of the enamel from the wire and tinning that point. Leads at each end of the coil are bent to shape to fit the board and the leads are cut to length, the ends cleaned and tinned.

*The layout of components around the crystal oscillator when using third overtone crystals. Slight changes will be necessary for fifth overtone crystals.*

For frequencies below 25MHz or so, the aerial coil may be wound on a Neosid 7.6mm former, with slug and can. The aerial coil consists of a primary and a secondary winding, with the secondary wound first. The start and finish of this winding may be anchored in position with a small piece of adhesive tape. This is slipped under a few turns at each end during winding. The end protruding is then folded over the top of the winding when completed. The primary winding is wound over the bottom end of the secondary, after having placed a piece of tape over that part of the secondary. Again, tape is used to anchor the winding in place.

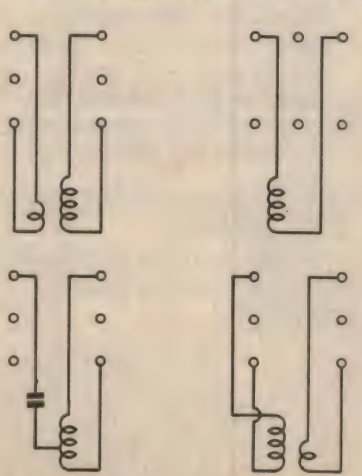
If you are using a first IF of 3.5MHz or higher, then you may follow the details in the table for the output coil. Winding procedure is the same as for the aerial coil just described, except that references to primary and secondary windings will be reversed. It should be noted that this coil needs two slugs to make it tune to 3.5MHz with a shunt capacitance of 82pF, but it is possible to make it tune up to at least 5MHz by omitting one slug and reducing the capacitance to 47pF. If you wish to go higher in frequency, it will be necessary to reduce the number of turns on the primary winding. The number of secondary turns should be kept to about the same ratio as at present.

Where a coil is needed for the crystal oscillator, in the case of overtone operation, details may be obtained from the appropriate information relating to the particular oscillator. Although these coils are wound on Neosid 7.6mm formers, a fairly heavy gauge of wire is used and the coil is quite easy to wind. We did not use a can over this coil in our prototype but when purchasing these formers, they usually come as a packaged assembly, complete with can. In the circumstances, the can may as well be used and it also helps the overall appearance of the unit.

To ensure that the windings of all coils wound on formers stay firmly intact, they should be given a coat of cellulose lacquer or other suitable material. When dry, the leads should be terminated such that when the coil is fitted to the board, the pins correspond with the relevant parts of the circuit. This is shown in the diagram.

Now we come to the assembly of the printed board. This version of the series of converters is perhaps more challenging than the others in that you are left to work out some of the details for yourself. Although the task is reasonably straightforward, it is advisable to approach it in a systematic manner. A good place to start is with the resistors, followed by capacitors and other small items, including the transistors. Do not overlook links where they are needed; these may be a piece of tinned copper wire or even a scrap of pigtail from a resistor. In some instances, it is more convenient to place small components

## COIL WINDING DETAILS



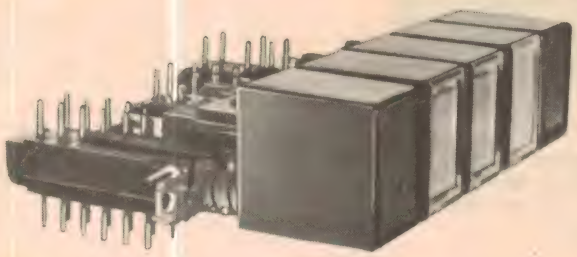
COIL CONNECTIONS VIEWED FROM ABOVE

*AERIAL COIL:*
*2-6MHz. Secondary 85 turns 28B&S enamel c/w on 7.6mm former with slug. Primary 10 turns 28B&S enamel over earth end of secondary.*
*6-19MHz Secondary 18 turns 22B&S enamel c/w on 7.6mm former with slug. Primary 2 turns 28B&S (or 22B&S) enamel over earth end of secondary.*
*52-54MHz 8 turns, tapped 2 turns from earth end, 18B&S enamel, ½in ID x 21mm long.*
*70-85MHz 5 turns, tapped 1 turn from earth end, 18B&S enamel, ⅜in ID x 11mm long.*
*118-136MHz 3 turns, tapped ¾ turn from earth end, 18B&S enamel, 5/16in ID x 8mm long.*

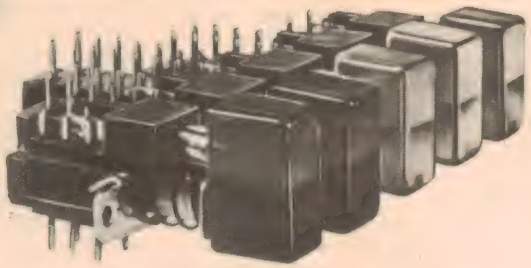
*CRYSTAL OSCILLATOR COIL:*
*Fundamental. No coil required.*
*Third overtone. See table for third overtone oscillator.*
*Fifth overtone. See table for fifth overtone oscillator.*

*IF OUTPUT TRANSFORMER:*
*1.6MHz. Standard broadcast aerial coil used back-to-front. RCS type 221 or similar.*
*3.5MHz. Primary, 120 turns 28B&S enamel c/w on 7.6mm former with 2 slugs. Secondary, 12 turns 28B&S enamel over earthy end of primary.*
*Note: All coils where necessary are tuned with appropriate capacitance.*

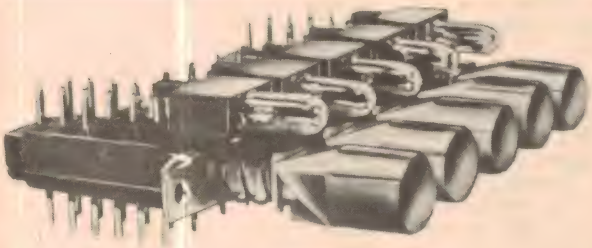
# We've got style!



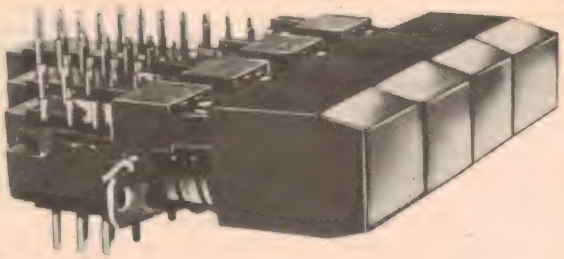
Style 2.
Button with snap-in lens 15 m.m. pitch.



Style 3.
Integral button frosted for maximum light dispersion 10 m.m. pitch.



Style 4.
Round button with rear prism for maximum light transmission 12.5 m.m. pitch.



Style 5.
Button with three sided snap-in lens 15 m.m. pitch.

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**You can make your choice of the exact style of illuminated buttons to complement your equipment styling.**
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By proven vibration-proof incandescent wedge-base lamps.
6, 12, 24 and 30 volt (30 mA or 1 watt).

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Illuminated button pitch spacings; 10 m.m., 12.5 m.m. and 15 m.m.
Push on-Push off and Interlock (½ Million operations).
Momentary (1 Million operations).
Lockout and Solenoid operations available.
Can be mounted on Printed Circuit Boards or hand soldered.

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Silver *Laminate* contacts, self wiping. Low contact resistance — low capacitance.
Sealed contacts impervious to solder, flux or dust.
Replacement contact shaft with new contacts can be quickly inserted from the front.

## RATINGS

A.C. Modules; 2 Amps at 250 volts A.C.
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Accepted by the S.E.C.V. for mains connection.

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73/1/SW

underneath the board. The 1pF injection capacitor and the 0.1uF source resistor bypass capacitor are a couple of examples.

The board was made to accommodate Neosid coil formers but there may be some instances where it is desired to use an output transformer made by RCS Radio. In such cases some care will be needed in fitting this transformer. The following procedure is suggested.

Cut off the fifth pin close to the moulding so that there is no chance of it being short circuited later on. This pin is the one close to one of the can mounting lugs and is normally a tap from one of the windings. Now bend each of the remaining four pins over so that they lie across the corners of the can. Then the pins are bent in dog-leg fashion such that they will enter the four holes in the printed board. The can mounting lugs must also be bent inwards and in a similar manner so that they will also pass through the respective holes in the board. This done, the can may be mounted — but care must be taken to ensure that it is orientated correctly, according to the code on the circuit and that moulded adjacent to the pins.

Where it is applicable, having mounted the coils in their cans and bent the lugs over, each assembly may be fitted to the printed board, again taking care that it is orientated correctly. The Neosid assemblies are fixed to the board with two 6BA screws. If 6BA screws are unprocurable in your case, the alternative is to re-tap the holes to ⅛in Whitworth.

With the board assembly complete, the next consideration is to mount the board in some convenient manner. We have provided four mounting feet ½in long, to stand the board off and with these feet, the assembly may be fitted to a metal box, with input, output and supply leads. Dictated by the actual physical requirements, leads should be fitted to the aerial input, earth, IF output and the 9V supply points. The leads should be of sufficient length to reach the terminating position when the assembly is finally mounted.

At this stage, a careful check should be made to ensure that no errors have been made. Satisfied that all is well, the board may now be mounted in its final form, still giving access for adjustments to be done later on.

The converter is now ready for adjustments. We will assume that you have a suitable receiver into which to feed the converter. A source of 9 volts at a couple of milliamps should also be available. Ideally, if the receiver has a suitable supply, then the converter may share it. On the other hand, a separate 9V battery may be used just as well. We will also assume that you have an aerial suited to the frequency of interest.

Connect the converter to the receiver, a source of power and for the present, we will assume that a signal generator is available. Switch on the converter, set the receiver and the generator both to the first IF, and adjust the slug in the converter output transformer for maximum response.

If your crystal is below 21MHz, there will be no coil to adjust but the trimmer may be used to set the crystal precisely to frequency, if the facilities are available. If precise frequency adjustment is not contemplated, then the trimmer may be set to its mid-position.

In the case of third and fifth overtone crystal oscillators, the conditions are rather different. In an article by an expert on the subject and which we published in November, 1972, certain suggestions are made regarding adjustment of these oscillators. "With the crystal in circuit, L1 should be adjusted for either (a) minimum RF voltage across the crystal or (b) for the exact frequency required." If you can do this, fine — but probably only a few readers will have the facilities necessary. However in the same article another statement is made: "With the crystal short circuited the oscillator should operate at or near the required frequency." This is possibly the best guide for the average person and the one which we suggest should be followed.

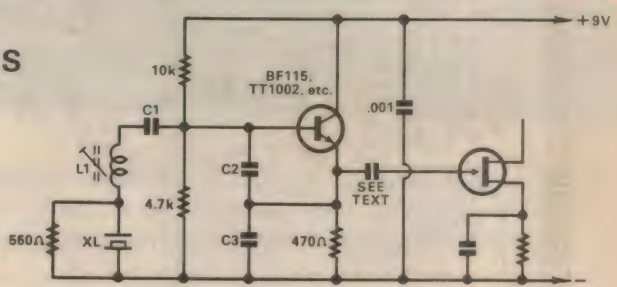
This method of adjustment is appropriate for both fundamental and third overtone crystals. However if you take another look at the circuit for a fifth overtone crystal, you will see that literally short circuiting the crystal would mean depriving the transistor of bias, no doubt with inconvenient consequences. Happily "short circuiting" in this case does not necessarily mean the use of a solid conductor. It would be sufficient to use a large capacitance, say about .001uF or higher and preferably a non inductive type such as a disc ceramic.

Having adjusted the oscillator, set the signal generator to the frequency of the signal to be received and feed the generator into the input of the converter. Adjust either the aerial coil slug or trimmer, whichever is appropriate, for maximum response. This completes all adjustments and the converter is ready for use.

Should a signal generator not be available, then you will probably have to rely on the wanted signal for alignment purposes. However, the crystal oscillator will be adjusted as described previously. Then set the receiver to the first IF, adjusting the receiver and the ouput transformer of the converter for maximum response. In turn, the slug or trimmer of the aerial coil should be adjusted for maximum response.

Given an efficient aerial system and provided it is used with a receiver of reasonably good sensitivity, this simple little converter can give a good account of itself.

## CIRCUITS FOR VHF OSCILLATORS

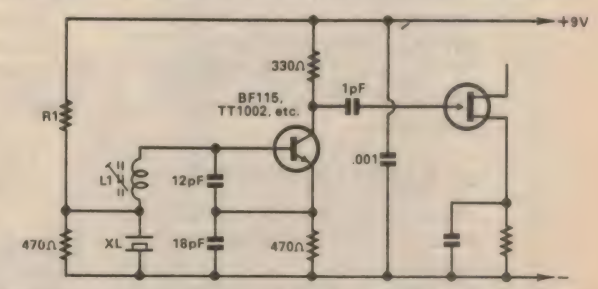



*Recommended oscillator circuit for 15-63MHz third overtone AT cut crystals.*

| F (MHz) | C1 | C2 | C3 | L1 |
|---|---|---|---|---|
| 15-20 | 100pF | 100pF | 68pF | 12 Turns 30 B & S closed wound |
| 20-26 | 100pF | 100pF | 68pF | 8 Turns 30 B & S close wound |
| 25-31 | 100pF | 68pF | 47pF | 8 Turns 30 B & S close wound |
| 30-43 | 100pF | 68pF | 47pF | 6 Turns 20 B & S close wound |
| 42-55 | 100pF | 68pF | 47pF | 5 Turns 20 B & S 6mm long |
| 48-63 | 68pF | 33pF | 15pF | 5 Turns 20 B & S 6mm long |

L1 is wound on 7.62mm diameter former with Neosid F25 core.

N.B. Under no circumstances should a tuned circuit at the crystal overtone frequency be included in the collector circuit as this configuration will result in oscillation not controlled by the crystal.




*Recommended oscillator circuit for 50-105MHz fifth overtone AT cut crystals.*

| F (MHz) | R1 | L1 |
|---|---|---|
| 50-70 | 2.7k | 7 Turns 6mm long) |
| 60-85 | 2.7k | 5 Turns 5mm long) |
| 80-105 | 1.2k | 3 Turns 6mm long) |

Wound with 20 B & S enamelled wire on 7.62mm diameter former with Neosid F29 Core

N.B. Under no circumstances should a tuned circuit at the crystal overtone frequency be included in the collector circuit as this configuration will result in oscillation not controlled by the crystal.

# An Introduction to Marine Acoustics

PART THREE

In this final article of the series, a number of projects are outlined, several of which could well find a place in the building programme of the electronics hobbyist who wants to branch out into something new.


**by J. D. PENROSE Ph.D.**

(Physics Dept, West Australian Institute of Technology)


Most of the projects discussed in the article are described fairly fully in readily accessible literature, so it will be sufficient here to give a brief outline of each, together with a few notes about some of the practical difficulties that are likely to be encountered in their construction.

The first project is concerned with the topic of under-water communication between divers and raises the fundamental issue of acoustic impedance matching. It will be useful to discuss this before treating the project itself.

Can we talk and hear underwater? The simplest way to achieve verbal communication between divers, or a diver and a boat would seem to be to treat the water in the same way as air, that is, to attempt to speak and listen in the normal way, at least between gulps of air from an aqualung! We know that water transmits sound well, particularly in the audible range, and yet a few minutes experimenting will show that only a feeble and distorted communication results if two divers attempt to speak directly into the water.

The greatest single contributing factor to this poor communication link would appear to be the difficulty of adequately transmitting speech into the water from the air space in the vocal tract from which the sounds are formed. This in turn arises primarily because of the poor acoustic impedance matching that an air-water boundary provides.

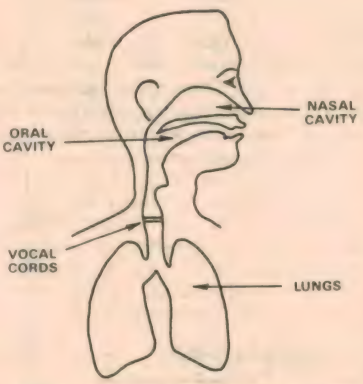
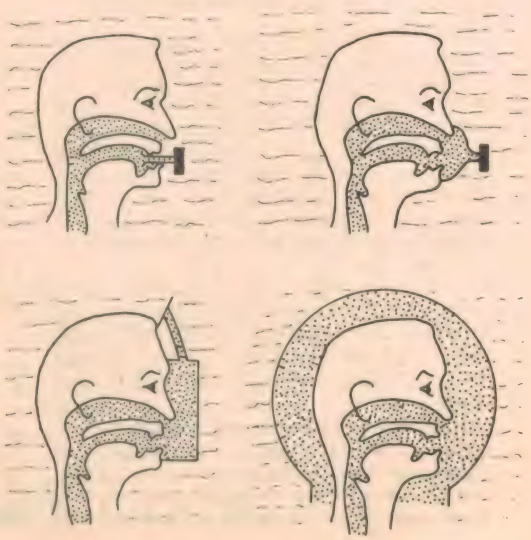



*Fig 1: Illustrated above are the air spaces associated with the speech generating system. A diver attempting to speak directly into the water has to overcome an air-water interface somewhere in the mouth region.*

*Fig 2 (right): Schematic representation of the space spoken into for a mouth bit, oral mask, full face mask, and a diving helmet.*



In the first article in this series, the specific acoustic impedance, Z, of a medium was defined and two examples given were:

Z for air at one atmosphere and 20C = 415 Rayls
Z for seawater = 1,500,000 Rayls

Reflection of sound arises when a sound wave crosses the interface between two substances with different Z values. The greater the Z difference (ie the greater the impedance mismatch) between the two media, the greater the reflection. This result can also be stated as "the greater the impedance mismatch between the two

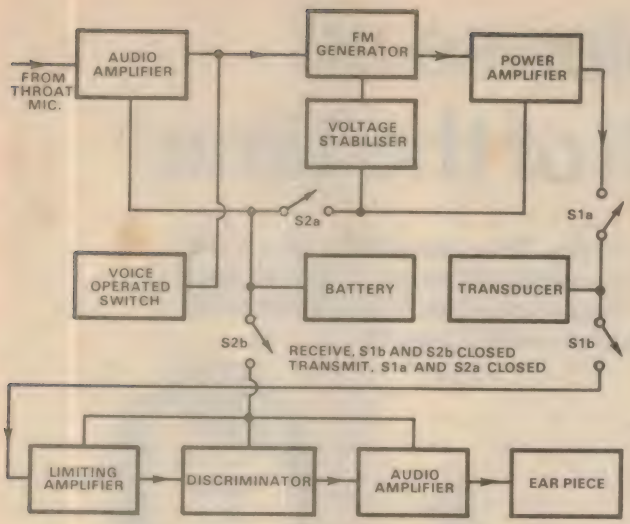



*Fig 3: Diver communicator layout due to Gazey and Morris.*

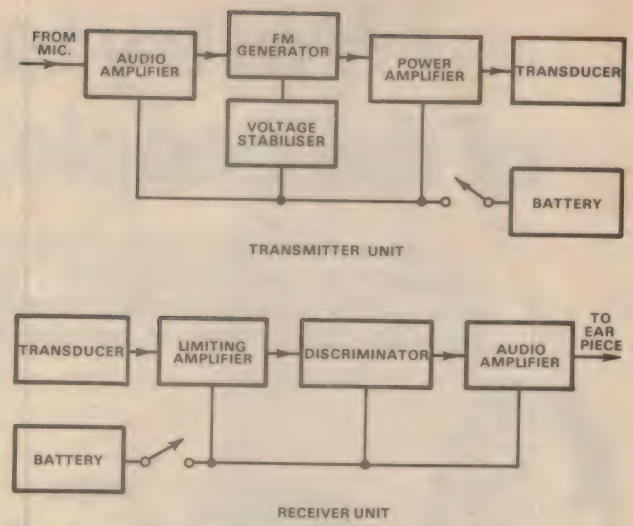



*Fig 4: Modified communicator layout.*

media, the less the transmission across the interface".

Fig 1 shows the impedance matching problem facing the diver attempting to speak in water. At some stage the sound produced by the vocal chords has to enter the water. For sound waves incident at right angles on an air-water boundary, the following result applies:

The sound power transmitted is equal to the incident power multiplied by 4 times the Z factors of air and water, but divided by the square of their sum.

Since Z air is 415 Rayls and Z water is 1,500,000 Rayls, a close approximation to the above would be:

The sound power transmitted is equal to the incident sound power multiplied by 4 Z air, Z water but divided by Z water squared.

It transpires that only about 0.1% of the power contained in the speech will enter the water across such an interface. This value will be modified slightly as the diver is subject to the higher than atmospheric pressures of diving and possibly by the acoustic behaviour of his neck and face regions. However, the general conclusion of poor impedance matching leading to inefficient power transfer, remains true.

Another very severe problem in underwater voice communication is still evident even when the impedance mismatch difficulty is overcome. If the diver is equipped with some kind of communication device which properly projects his speech signal into the sea, it will then present him with a microphone which needs to be inserted in the air space near his mouthpiece or used as a throat microphone. In either case it is necessary for the diver to articulate into a fairly small air space. This is represented in Fig 2 which shows the spaces associated with four types of diving gear.

These spaces, most particularly the smaller ones, are sufficiently small to become a component of the complex human resonator formed by the vocal tract. The result is that clear speech is difficult to produce when diving, even when the breathing gear does not enter the mouth. Nonetheless, sufficient clarity for most purposes can be achieved if the impedance matching problem for transmission can be solved.

Diver reception of sound underwater has been the subject of considerable study. Two main methods of sound entry into the head have been found. Firstly, even if an air bubble is trapped in the ear canal, some sound does enter by that path. Secondly, the bone of the skull, which matches reasonably to water, is capable of detecting sound and transmitting it to the ear region. The result is that diver communication devices may use the kind of earphone described in the last article, which primarily links to the ear canal, or some type of bone conductor.

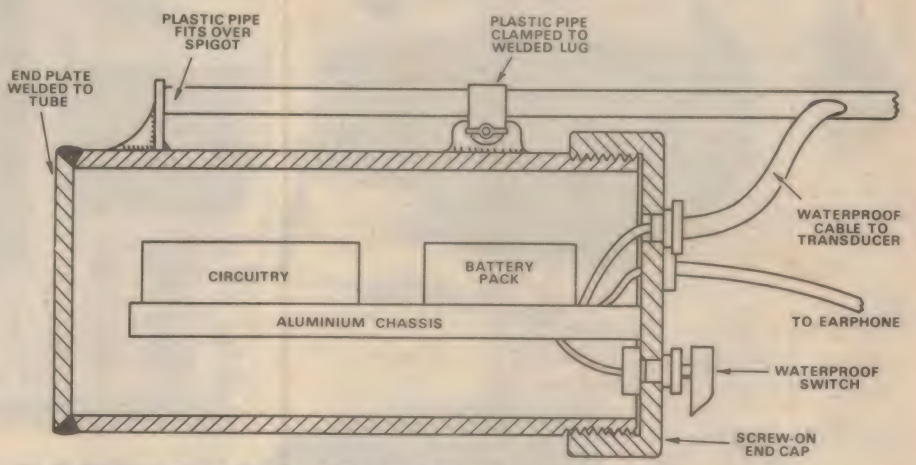



*Fig 5: Constructional details of the receiver unit.*

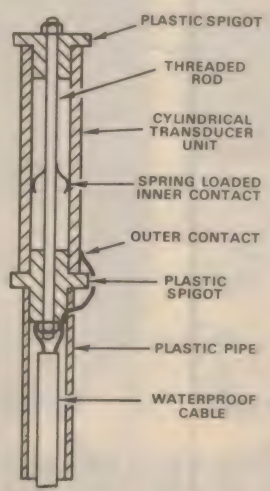



*Fig 6: The mounting arrangements for the transducer. After assembly, the whole unit is encapsulated.*

Several approaches have been used in the design of sonic communication systems for divers, involving boat-diver links and / or diver-diver links. Some methods have resulted in commercially available units and most have used a voice modulated ultrasonic carrier. The carrier frequency usually lies in the range 60KHz-200KHz which enables some rejection of the low frequency noise components found in the sea. Fig 3, in the last article in this series showed that the noise spectrum of the sea is dominated by components in the audio frequency range and below.

Both amplitude and frequency modulation techniques have been employed, although the combination of reasonable voice bandwidth and low, by radio standards, carrier frequency means that choosing the overall system bandwidth presents special problems.

Over the past several years, students in the Physics Department of the Western Australian Institute of Technology have constructed a diver communication system as a class exercise. During the three year course for the Bachelor's Degree in Applied Physics, students undertake three units in Experimental Methods, which include electronics and lay considerable emphasis on project work.

A number of students have used the communicator project as an exercise in

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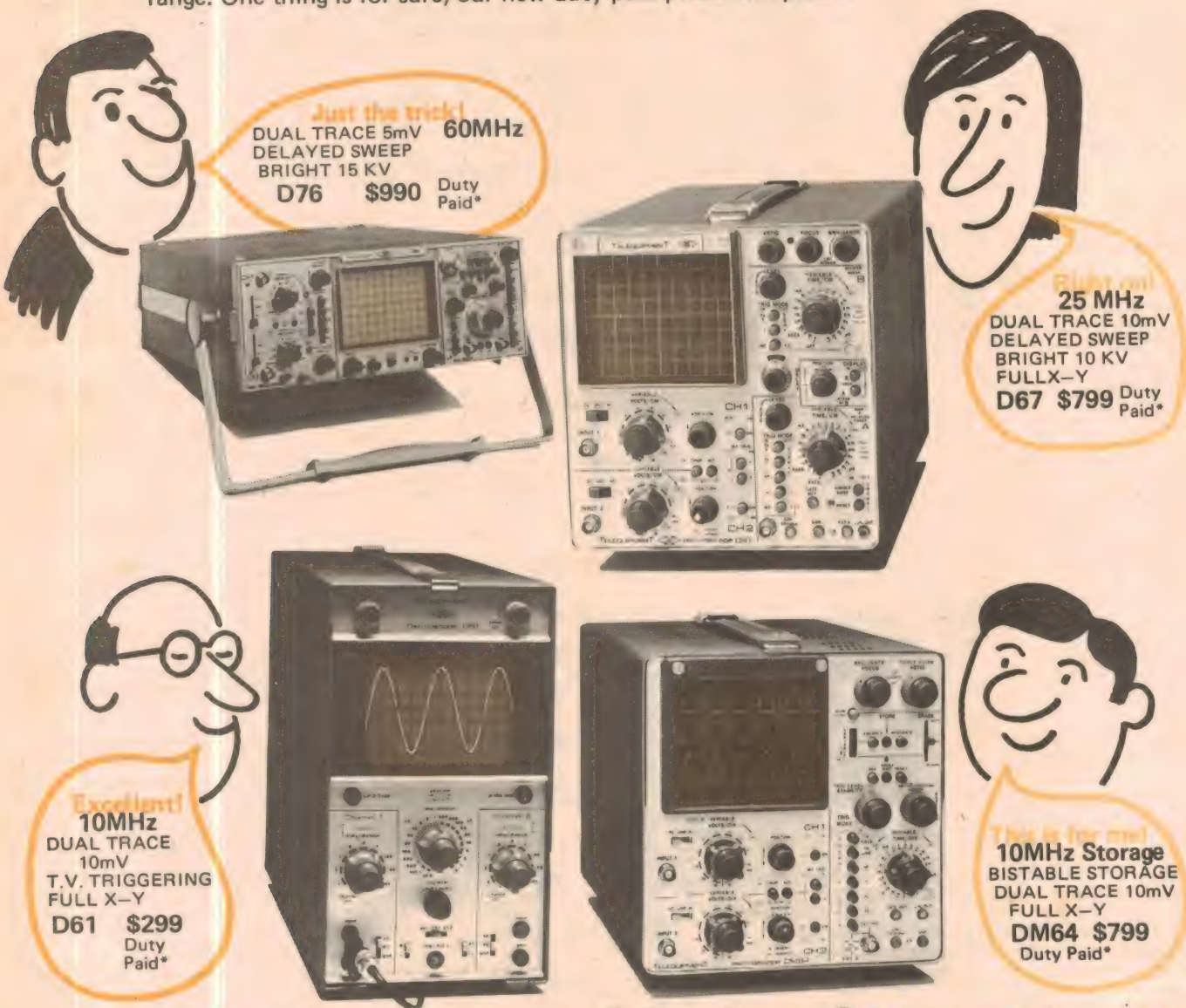


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electronics construction and acoustic design and the system has so far given a link over about 200 metres, with both transmitter and receiver operating from surface locations.

The system was developed from a published design, due to Dr B. K. Gazey and Dr J. C. Morris of the University of Birmingham. The original article, entitled "An Underwater Acoustic Telephone for Free-Swimming Divers" was published in the journal "Electronic Engineering" for June, 1964, pages 364-368. The system uses FM and a carrier frequency of 120kHz with a bandwidth in the region 5kHz-10kHz. The transmitters put about 1 watt of acoustic power into the water, giving the system an operating range of up to 500 yards. Shallow water, reefs and surface reflection interference at short distances can affect the range.

The general layout of the original system is shown in Fig 3. The electronics were made up of discrete components, throat microphones and bone conductor earphones were employed and the transducers used were electrostrictive cylinders of one inch length and half inch outside diameter.

This system was modified and simplified for use as a class exercise and Fig 4 shows the modified form. It is essentially a one-way version of the original, still with discrete circuitry, but with modified and updated components. The voice input from the microphone is applied to the bases of the transistors in an astable multivibrator and varies the multivibrator frequency to provide an FM signal. The signal is taken via an emitter follower to a complementary symmetry power amplifier which feeds the transducer.

The receiver uses a limiting amplifier to produce a train of rectangular pulses which are demodulated by what is essentially a diode pump and the resulting audio signal is amplified and applied to the earphone. Although the circuitry is simple and provides inherent distortion, the major problems encountered in building and testing the unit were associated with housing the assembly adequately, obtaining parts and providing adequate test facilities. Fig 5 shows the housing assembly used for tests of the prototype receiver. This housing was made in a few hours to enable field tests to be tried and should be fairly easy for most hobbyists to obtain. With suitable assembly care, it appears to be leakproof to a depth of at least twenty feet.

A twelve inch length of four inch diameter galvanised steel pipe threaded on one end was obtained from a local steel supplier, together with a matching screw-on end cap. The unthreaded end of the pipe was carefully closed off with a welded plate so that, when the cap is screwed on with a suitable non-setting jointing compound on the threads, the assembly is watertight.

The circuitry is mounted to an aluminium chassis araldited to the underside of the screw cap and various ancillary lugs, switches, etc, are welded or glued to the pipe and cap. The cylindrical transducer assembly is mounted on a length of flexible plastic pipe as shown in Fig 6 and the pipe is attached to the case by a simple clamp and spigot assembly. Wire and switch lead-ins through the cap are provided by simple neoprene seals and the earphone is as detailed in the previous article.

Fig 7 shows a view of the completed receiver unit. The transmitter uses a similar transducer assembly and houses the electronics in a metal box.

Fig 8 shows a heavy duty housing used for an industrial project. Some adaptation of this approach could be used for housing construction for a prototype diver unit, but considerably more workshop capacity would then be needed than is required for the simple screw together assembly. A fully developed diver unit would need, of course, a smaller assembly more suited to belt or helmet mounting.

While underwater earphones and, if necessary, microphones, represent supply difficulties, the greatest single supply problem concerns the cylindrical transducer units which are difficult to import in small numbers, and not readily available from the one Australian manufacturer.

*Fig 8 (above): A heavy duty housing assembly, of the type which can be provided if workshop facilities are available. Sealing is achieved with neoprene O-rings.*

*Fig 7 (left): The completed receiver unit as per the diagram in Fig 5. The transducer is on the end of the flexible plastic pipe, while the earphone is in the foreground.*

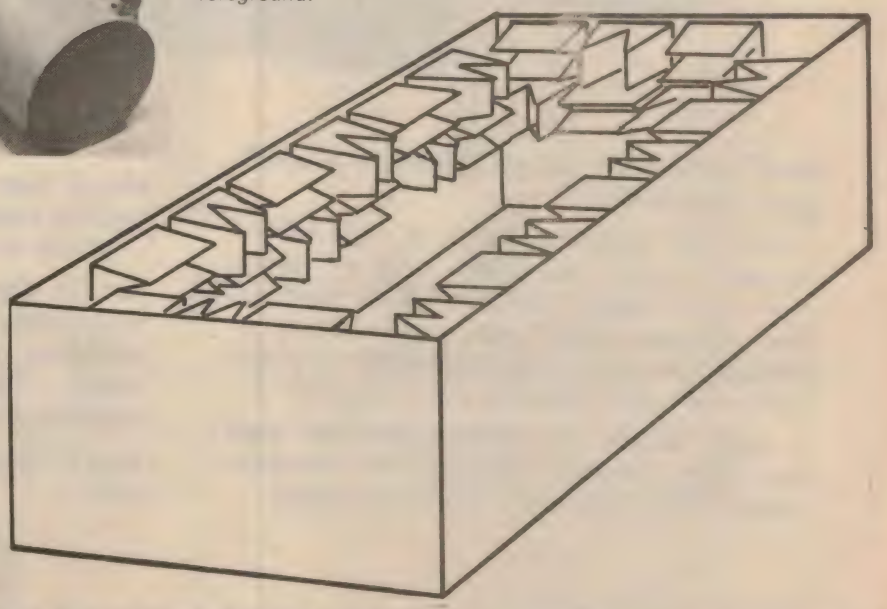

***Fig 9: The anechoic test tank. For clarity,** the tank is depicted without the lower layers of wedges. The concrete wedges are cast in pairs in a steel mould. The tank measures 6ft x 3ft x 2ft.*

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Although the much cheaper ceramic discs have less desirable directional properties than cylindrical units, they would certainly be adequate for much prototype development and are available from several Australian suppliers.

While bench testing of the electronic circuitry presents no new difficulties, testing the system acoustically is difficult in the laboratory or workshop situation. Some guide to performance can be obtained by immersing both transducers in a container of water, but the acoustic echoes set up in the container make assessment very difficult.

One solution developed by the students working on the project was to construct an anechoic test tank. This is shown in Fig 9 and is a large metal tank lined with concrete wedges. The wedges, by a combination of absorbtion and total internal reflection, strongly attenuate any sound

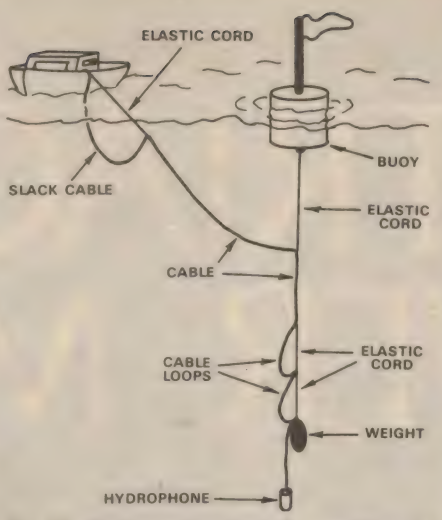
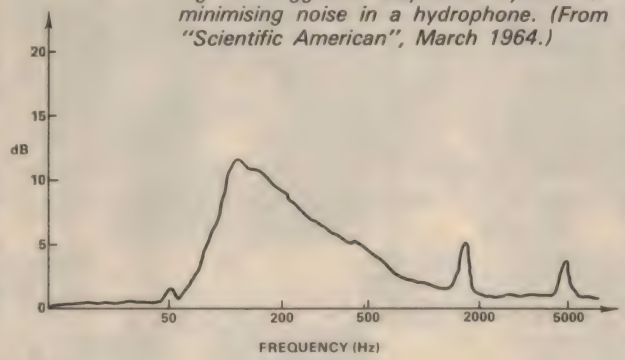



*Fig 10: Suggested suspension system for minimising noise in a hydrophone. (From "Scientific American", March 1964.)*

*Fig 11: The spectrum of feeding noises made by Western Rock Lobster in the laboratory tank aquarium. While of interest, it does not necessarily follow that the lobster will behave in an aquarium as it does in its normal habitat. The plot may also reflect some acoustic properties of the aquarium.*



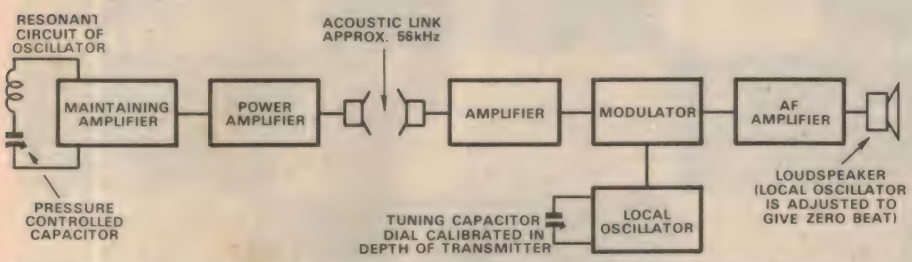




*Fig 12: Depicting a depth telemetering system developed at the National Institute of Oceanography in Britain. Its operation is described in the text.*

falling on them and thus reduce echo strength considerably. This tank has proven invaluable in testing and de-bugging the communicator and other marine acoustics projects.

Another project area which is being explored is that of underwater sound recording. This somewhat unusual field is of particular interest to biologists since many marine animals make characteristic noises. Some fish, many crustaceans and the few mammals in the sea may be picked up by a suitable recording system. The role, if any, of the sounds produced for navigation or communication is not clear in the case of the fish and crustaceans and research into the sounds they make continues to be an engrossing subject.

Three ways of making underwater sound recordings have been explored by students from the Physics Department of the Western Australian Institute of Technology. These are:

(1) recording from a boat; (2) in a laboratory tank; and (3) from an underwater tape recorder operated by a diver.

The first of these methods, boat based recording, has not yet been tried experimentally at W.A.I.T., but excellent discussions of the subject, together with instructions for making simple hydrophones appear in the "Amateur Scientist" sections of the Scientific American magazine for October, 1960, and March, 1964.

Fig 10 shows a recommended method of hydrophone suspension from a boat such that surface noise and noise signals due to boat motion jerking the hydrophone are minimised.

Recording in laboratory tanks is sometimes useful, even though tank echoes can be expected to modify the signal received, even in the best anechoic tanks available.

Fig 11 shows the frequency dependence of the noises made by a feeding Western Rock Lobster for a specimen in a laboratory aquarium. Several prominent features are seen in the spectrum and some of these may be attributable to the particular acoustic properties of the tank used. Also, from the biologist's point of view, the tank environment may influence the lobster's behaviour and it would seem that the most suitable situation for recording experiments of this kind would be the natural habitat of the animal. A portable underwater tape recording system is currently under development within the Physics Department at W.A.I.T. to pursue this idea.

Many other ideas within Marine Acoustics lend themselves to the interests and energies of electronics hobbyists. Perhaps the most challenging of these are projects directed towards conserving the marine environment. The role of marine acoustics is largely in telemetry in such projects and, to conclude this series of articles, a simple telemetering device will be outlined.

This system simply transmits to a boat mounted receiver, an ultrasonic signal which has a frequency dependent on the depth at which a transmitter is operating. The transmitter may, for instance be attached to a sampling net towed behind the boat, and detects depth by the effect of water pressure on a pressure sensitive capacitor which forms part of a transmitting resonant circuit. The device is described in detail in the journal "Deep Sea Research", volume 10, 1963, pages 471-478, and the work is due to four scientists from the National Institute of Oceanography at Godalming in the south of England.

Fig 12 summarises the system. The pressure controlled capacitor governs the transmitted frequency which varies over a small range around 56kHz. This frequency is transmitted over a range of up to 1200 metres to a receiving hydrophone and the received signal is amplified and mixed with a tunable local oscillator.

This oscillator has its tuning facility calibrated in terms of water depth so that when the subtractive heat frequency between local and received frequencies is reduced to zero, the depth of the transmitting unit may be read directly from the tuning dial of the local oscillator control.

This application of marine acoustics shows clearly the way in which existing techniques in radio and associated fields are suited to many areas of enquiry and application in the science of the sea growing so strongly in Australia today. In some of these areas, new and untried projects await the constructor and a great deal of satisfaction can be had in grappling with such projects, perhaps most of all, those related to the conservation of our seas.

In Australia, there are many people who are enthusiastic about electronics but who have had no underwater experience. The reverse is also true. Relatively few possess skills in both areas.

## Background to an Australian

# Quadraphonic Recording

What kind of planning goes into the production of a modern commercial recording, destined for release on two-channel and four-channel disc, open reel tape and cassette? The question is answered by Malcolm Abel, producer of the recent Australian release "Top Brass."

**by MALCOLM J. ABEL**

Having listened to some of the best quadraphonic recordings on CD4 and SQ discs and on reel to reel tape, we decided that a Big Band recording which we already had under way would lend itself admirably to 4-channel reproduction. This recording, entitled "Top Brass," features the Peter Lane Big Band and was planned to appeal to a wide range of tastes. Moreover we felt that this particular recording could be more than just a run of the mill production. It would be quite a good project to use for quad demonstration purposes.

To avoid any degree of compromise we decided to optimise the normal stereo recording for reproduction in conventional systems and the 4-channel recording for quadraphonic systems. This meant that the balancing and mixing techniques and reverberation time constants were entirely different for the final master tapes, thus providing the fullest exploitation of both mediums of reproduction.

It has been our practise to hire the studio most suitable for any particular project and in this case we selected the studios of United Sound Pty Ltd of Sydney, primarily because they had recently installed a new twenty-four channel mixing console constructed by Automated Processes Inc New York (USA). This console incorporates a most comprehensive range of control facilities as required for quadraphonic recording.

The Studio measuring 52 x 28 feet was especially designed by Mr Ron Purvis of United Sound for optimum environmental control of orchestral or other forms of musical recording, having ceiling panels with adjustable height and orientation and walls devoid of parallel reflective surfaces.

We were fortunate also to obtain the services of Mr David Woodley-Page whose long and varied experience as a recording engineer with major recording studios in Sydney has made him our first choice in all recent activities. David's knowledge of what makes musicians and equipment tick enables him to obtain top performance in both areas, with a minimum amount of wear and tear on both.

Quite a lot of thought was given as to how best to locate musicians and microphones and what types of microphones to use for each particular instrument. This led to the arrangement illustrated, which was found to provide just the right discrete sounds from the right, left, front and back locations.

Microphones were chosen primarily on the basis of their pickup patterns, since sensitivity and frequency response were readily adjustable at the mixing console. However, the electric bass guitar was plugged directly into one mixing channel and equalised to achieve the sound appropriate to the particular piece of music.

When recording on multi track equipment, the orchestra is divided into sections which are split at the mixing console and recorded on separate tracks of the tape. In this case we used a Scully model 284-8 multi-track recorder and Scotch type 207 (one inch wide) tape.

Recordings made on multi track equipment, such as this, can be precisely balanced and mixed in the configuration required long after the musicians have gone home. This relieves them of the otherwise laborious task of repeated performances in order to obtain the best overall sound.

It is therefore important that instruments recorded on separate tracks are not picked up to a significant degree on other microphones. This acoustic spillage would defeat the purpose of separate tracks by introducing "cross talk" at the point of origin. Microphone pickup pattern is obviously of paramount importance in the elimination of this problem.

Where it was difficult to achieve a sufficient degree of isolation by the use of microphone polar patterns, we used movable acoustic screens. They were used around the percussion department particularly, because cymbals tend to find their way into everything within hearing distance.

It may be of interest to note that seven microphones were necessary to record the drum kit. A "close miking" technique

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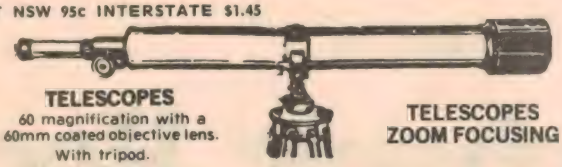

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*David Woodley-Page at the console in the studios of United Sound Pty Ltd. At left, trumpeters of the Peter Lane Big Band in action during the session.*

makes possible a better balance than is attainable by the use of a single overhead microphone, where a lot of other loud sounding instruments nearby can find their way into the drum sound.

From the foregoing comment and the diagram, it will be evident that the position of instruments in the studio bears no direct relationship to the appearance of their respective sounds in the final 2-channel or 4-channel mix. In essence, the placement of instruments in the studio is governed by the achievement of minimum spillage between microphone channels.

For at least the past ten years the recording industry has recognised that the art of recording lies in the mixing or "balancing" process after the multi-track recording has been made ie in this case after the twenty four microphones have been channelled into eight or if need be up to sixteen tape tracks. It is then possible for the recording engineer and the producer, after deciding how they feel the orchestra should be spread, to move any group of instruments on a single track on the tape to any position in the quad or stereo mix by the use of a balance control commonly referred to as a "pan pot."

In this recording the stereo balance was as follows:

- Bass guitar, as is customary appears in the centre channel ie equally in both stereo channels.
- Trumpets left; trombones right; saxophones centre.
- Piano and guitar varied to suit item.
- Drums principally in centre with occasional variation in similar manner to solo instruments.

By comparison the 4-channel mix, with twice the number of variables, presented the opportunity for the creation of mood appropriate to the spirit of the music. Instead of just right, left and centre, with the possibility of panning along a single base line, we now have eight basic positions and variability along four base lines.

On most of the 4-channel recordings that we listened to prior to attempting this project, the low frequency notes appeared in the two front channels only. This meant that, if one was seated on one side of the room, there was a feeling that the other channels were not pulling their weight. We found that a better sense of presence was obtained by supplying each channel with an equal share of low frequency or bass since this carries the rhythm and has strong influence upon the mood of the music.

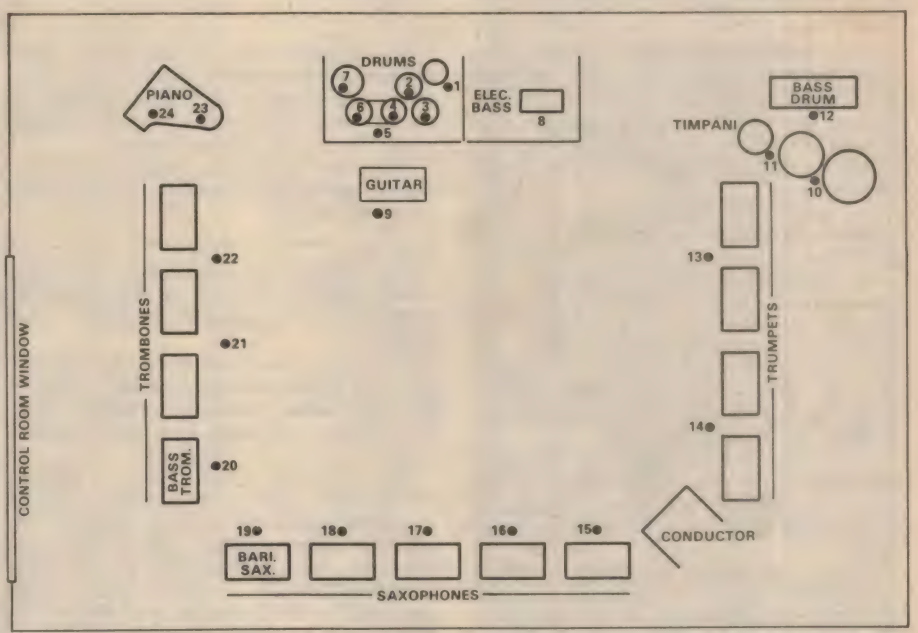
The common assumption that low frequency notes are non-directional was not a sufficient justification, we felt, against making them as universal as possible; the results appear to justify our viewpoint.

As in the 2-channel mix, the trumpets appear at front left and trombones at front right. However a pleasant atmosphere was created by placing the saxophones in the rear speakers, since they carry the mellow tenor harmonies. Using this balance as a basis, piano and guitar were panned mid right and mid left ie in centre channel between front and rear right and front and rear left speakers. This meant that, no matter which side of the quad you listen from, you are provided with distinct stereo sensation supported by the full quadraphonic program.

In 4-channel it was possible to entirely emphasise the stereo image by utilising the quad pan pot, especially on solo instruments and drums. This does not meant that, for instance, the drums were continually marching around the room, while this would doubtless be considered a novelty on first hearing, it would soon become an irritation to many listeners. It was possible however, to introduce the subtle dart around the room where the mood of the music was enhanced thereby.

Again, the effect of a musician wandering around the tables in a restaurant, playing

*(Continued on Page 125)*




*Layout of the instruments and microphones within the studio. Key to the numbering is: 1, hihat, Shure 545; 2, snare, Shure 545; 3, cymbal, AKG D24; 4, small tomtom, AKG D202; 5, bass drum, Beyer M360; 6, cymbal, AKG D24; 7, big tomtom, AKG D190C; 8, electric bass, direct injection; 9, guitar, Beyer M360; 10, 11, timpani, RCA 44BX; 12, bass drum, AKG D202; 13, 14, trumpets, Neumann U77; 15, 16, saxophones, Turner 500; 17, 18, saxophones, Turner 510; 19, saxophones AKG D202; 20, 21, 22, trombones, Neumann U77; 23, piano, Beyer M360; 24, piano, AKG D202.*

| TYPICAL 8-TRACK RECORDING PLAN | MIX DOWN | |
|---|---|---|
| Track Allocation | 2-Track Stereo | 4-Track Stereo |
| 1. Bass guitar | Equal R & L | Equal all tracks |
| 2. Percussion | Equal R & L | Front L |
| 3. Piano | L (left) | Front R, rear R |
| 4. Guitar | R (right) | Front L, rear L |
| 5. Trumpets | L | Front L |
| 6. Trombones | R | Front R |
| 7. Saxophones | Equal R & L | Rear R, Rear L |
| 8. Saxophones or solo instruments | Various | Various |

*Set out in the table above are the mix-down arrangements adopted by the Author for 2-track and 4-track versions of his "Top Brass" album. While the 4-track album can be played on 4-track equipment and vice versa, the mix-down has been varied to optimise results in each case.*

# FORUM

## A closer look at transistorised preamplifiers

One would have thought that the design of a transistorised microphone preamplifier stage would, by now, be a routine procedure. But don't you believe it. Our own "routine" effort attracted criticism in these columns in the June issue. Now the critic himself has earned a blast, in terms which themselves may not represent the last word on the subject.

You may recall that, in the June issue, a correspondent queried the very common practice of designing transistor preamplifiers to present an input impedance of around 50k ohms, to allow their use with conventional high impedance dynamic microphones.

He made the point that the high microphone impedance, normally achieved by means of an in-built step-up transformer, is a heritage of valve technology and requirements. In this solid-state era, it is possible to save the cost and escape the limitations of the step-up transformer; one can operate the microphone voice coil directly into a transistor preamplifier stage, having a low intrinsic input impedance but a very high gain.

In the course of the discussion he made reference to the noise advantage of a low source impedance, and also suggested a circuit for a balanced, matched impedance stage.

In reply, we agreed that he had made a logical case but we maintained that the carry-over in technology was largely one of convenience. At this stage, neither cost nor performance loss seemed to be critical factors and it was simply more convenient, for the time being, to retain compatibility between old and new microphones and old and new amplifiers.

We conceded that, in the future, there might well be a drift towards the use of lower impedance microphones, accelerated by the desirability also of using balanced rather than unbalanced circuits.

There we thought the matter would rest, but no: out of the blue came a letter in the following terms:

*Dear Sir,*

*I am afraid that Mr Williams has been sorely misled by N.McC. on the subject of microphone preamplifiers ("Forum," June issue).*

*It is simply not true that "for BC109, SE4010, &c at practical collector currents, optimum noise figures are obtained when the source resistance is a few hundred ohms."*

*The enclosed graph from a Mullard BC109 data sheet shows that a source resistance below 1k is only optimum for collector currents greater than 10mA, and then the noise performance is very poor compared with the overall optimum, which occurs for a source resistance of around 50k ohms and a collector current of around 10uA.*

*It is not surprising that his conclusion is also wrong; far from there being a conflict between the impedance requirements of valves and transistors, the 50k ohms nominal microphone impedance traditionally used with valves is, in fact, close to ideal for a well designed transistor preamplifier.*

*However, the correspondent does raise a valid point that there is an unnecessary deterioration of noise figure when a 50k microphone is connected across a 50k resistor at the input of an amplifier: attenuation before amplification is never advisable.*

*Yet an unexpected difficulty may arise if this resistor is not used. I have found that bass attenuation can occur due to the shunt inductance of the microphone transformer. For instance, the open-circuit output of a dynamic microphone of Japanese origin retailing at about $20 was found to be about 3dB down at about 200Hz, from this cause. Shunting the microphone improves the bass response, but at the expense of noise figure.*

*No doubt, in P.A. work the bass attenuation would be acceptable or even desirable but, for recording purposes, it is another matter.*

*A very elegant and effective solution to this problem is to shunt the microphone not with a physical resistor, but with the low input resistance of a virtual earth amplifier. It can be shown that such an input resistance generates very little Johnson noise, provided that the feedback resistor is large compared with the 50k ohms of the microphone.*

*Another interesting advantage of using a virtual earth configuration is that the capacitance of the cable is no longer a problem for reasonable lengths; it produces a reduction of the feedback loop gain at high frequencies but no direct treble attenuation.*

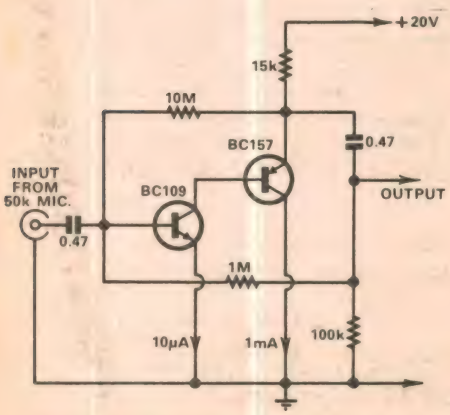
*You may be interested in the attached circuit for publication. Its simplicity belies its excellent noise performance, which is achieved by running the input transistor at a low current.*

*J.C. (Oatley, NSW)*

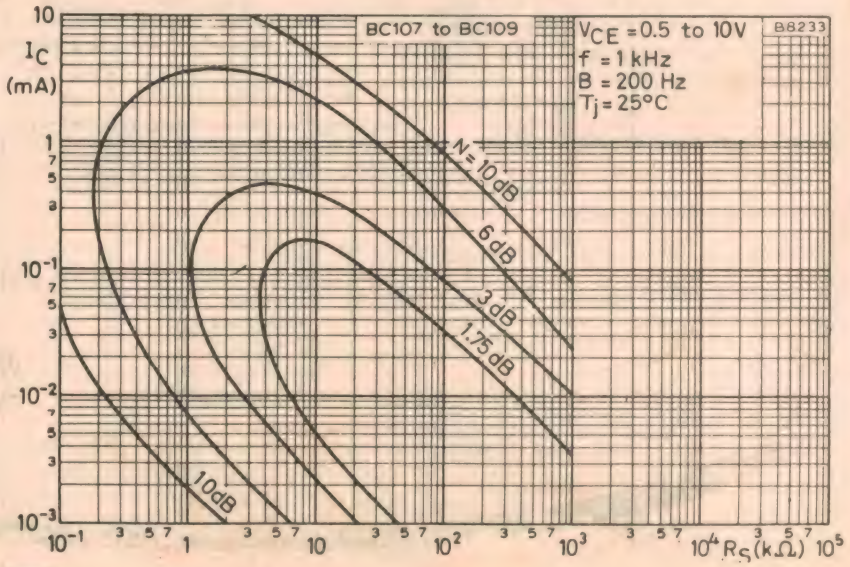
Well .....

In the terms of the foregoing criticism, we may seem to have been misled, particularly as our comment in the June issue read: "The point the correspondent makes is basically valid". It appeared that we were endorsing everything he said.

In fact, as the rest of the comment reveals, we were concerned primarily with the main issue: whether or not it was logical to continue to design for high impedance microphones. We offered an explanation for




*Based on an analysis of the curves on the right, the correspondent in the above letter criticises the critic in the June issue. He feels that the alternative circuit above has much to commend it.*



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the present situation but agreed that the basic advantages of low impedance circuits were not in doubt, particularly when carried to the next logical step of balanced low impedance circuits.

And there the matter was left, while we turned to another subject.

But buried in the original submission and our seeming acceptance of it was a statement that low source impedance provided an intrinsic contribution to good signal / noise ratio.

To be quite frank, we were so involved with the main line of the argument that we didn't stop to think about the particular statement.

But, fair enough. If we were so casual as to expose ourselves to a thrust, we can hardly blame J.C. for wielding the lance.

But I'm not sure that the situation is as simple as J.C. makes it appear. Sufficient to say that the subject promoted an animated discussion between Jim Rowe, Leo Simpson and myself, with enough points emerging to indicate that we could have kept it going most of the afternoon. Since we didn't have 3 man-afternoons to spare, I'll let you argue about it instead!

First off, the Mullard curve quoted by J.C. is for a narrow bandwidth of 200Hz centred on 1kHz. It would appear from other data that it is representative of noise characteristics above 1kHz, but that there is a steep rise in noise below 1kHz, due to a quite different cause. The question therefore follows as to whether the figures extracted from the narrow band curve apply for wide-band weighted noise.

If they do, J.C.'s point would be proven. The amendments put forward by the critic of our original circuit would deteriorate its noise figure from something close to the 1.75dB line to beyond the 3dB contour. This would tend to offset any advantage gained by improving the load / source impedance relationship.

Overall, in a typical P.A. situation, which is what we are talking about, the difference between the two preamplifier circuits would probably be quite small.

But while both critics have made a point about the significance to a transistor of source impedance, they have tacitly accepted the premise that a high impedance microphone branded 50k presents this order of impedance when viewed as a source.

This I would question. I doubt that it means much more than "high impedance" and with the implication that the microphone is intended to work into a load of about 50k ohms. Looking back into the cable, the microphone itself might present a complex phase / impedance curve bearing little relationship to the 50k figure.

Two implications emerge:

- If the impedance of typical high impedance microphones lies predominantly below 50k ohms, the assumption of a 6dB signal loss with conventional loading would need to be revised. J.C.'s figure of a 3dB improvement in bass response might even be a clue.
- Before one could become pedantic about noise level, one would have to relate the frequency conscious impedance of the microphone as a source to the frequency conscious noise characteristics of a transistor, with weighting thrown in for good measure.

Then there is the suggestion by J.C. of feeding a high impedance microphone into a near short-circuit, constituted by a virtual earth preamplifier. As a piece of transistor circuitry it may indeed be "elegant and effective" but it will not necessarily appear to be so from the viewpoint of the microphone.

I would judge that the average high impedance microphone is designed for optimum performance, based on the voltage delivered across a 50k ohm load resistor. Alternatively, it could be expressed as the current through the series resultant of the internal and external impedance.

It does not follow that the performance will still be optimum in terms of a current through an external path of very low resistance.

Commending the circuit J.C. says that the effect of cable capacitance is largely nullified. Perhaps so, but what about transformer leakage inductance, which would become more significant with a low external load?

I personally have not had occasion to look at typical high impedance microphones in this context but there is a possible parallel in magnetic pickup cartridges. These also are commonly designed to feed into a load of 47k ohms, and most amplifiers are designed to meet this specification.

Some years ago, however, a few amplifiers were released which presented a quite low input impedance to the pickup. The signal / noise ratio was very good for the period and, with some cartridges, the idea worked well. But, with others, the frequency response involving the interaction of internal and external impedance came out all wrong!

It became apparent that while most cartridges will work predictably into a 47k ohm load, as intended, they exhibit widely divergent behaviour when fed into a low and sometimes unconstant load. The same may well be true of high impedance microphones.

I would expect, frankly, that in a conventional P.A. situation all of the circuits in question would perform well but, since a couple of readers have chosen to "stir the pot", it has fallen to me to suggest that there is more in it than one might first suspect!

## SPARE PARTS

In my job as laboratory manager of a tertiary education centre, I come up against supply problems quite often.

Today's episode concerns an imported CRO, quite common in schools and seats of higher learning. One of ours has a faulty switch-pot — a standard 100k element with a dpst switch. The agent quoted 7 weeks delivery and local manufacturers are not interested in a "one-off" special.

The position is all the more ludicrous when one seés all kinds of outlandish combinations in the catalogues, so that Joe Blow's TV set will suffer a minimum of "downtime."

Surely the main culprit is the agent. Surely part of his job is to carry spare parts for the goods he sells. The pot in this case sells for under $1.50 before tax so even half a dozen on the shelf does not represent a small fortune lying idle. It seems to me that too many agents think more of "profit maximisation" than of service to customers.

D.B. (Carlton, Vic.)

# A dynamic noise filter and volume compressor unit

If you have operated a cassette deck as part of a stereo system you have most likely found tape noise to be a problem. For those readers who do not have access to a Dolby unit, this dynamic noise and filter unit submitted by a reader may be the solution. He claims that it will give excellent noise reduction on cassette tapes.

by R. I. DUNN*

This unit is based on an automatic tone control described by Goodell and Michel (see Ref. 1), in which incoming signals from a high pass filter are taken to a variable gain control element, phase inverted and mixed with the input. This produces attenuation of the high frequencies — the degree of attenuation depending on the gain of the control element.

With the circuit described here, incoming high frequency signals undergo reduced gain in proportion to their amplitude using, with some modifications, the volume compressor described by Simpson (2). After phase inversion the high frequency signals are mixed with incoming signals resulting in a dynamic high frequency filter. The threshold at which gain reduction occurs and the high-pass frequency bands are selected by external controls, allowing less loss of wanted high frequency content.

Incoming signals are separated into two (see diagram), one proceeding to the high pass filter Q2, the other to potentiometer R1. The pass frequencies are determined by the capacitor selected with Sw1. Q1 prevents the positive feedback from the filter reaching the mixing potentiometer R1. Q5 prevents low frequency signals triggering Q4 which supplies the control voltage to the LM 370 IC. Q3 in emitter-follower configuration is necessary for efficient operation of the IC and associated control voltage circuitry. The processed signal which is now out of phase with respect to the input is taken from Q5 and mixed with the other signal in potentiometer R1. The output is taken from the wiper of this potentiometer which is adjusted to give minimum noise when the control voltage on the IC is set to minimum.

The modifications to the volume compressor are to the control voltage circuit involving pins 2 and 4 of the IC. They are: a 20,000 ohm / volt, 5V FSD meter which enables monitoring and setting of the gain reduction threshold; a 4.7V zener diode to protect both the meter and the IC; a 4.7uF capacitor to prevent the audible compression noise produced by the IC when signals of rapidly varying amplitude are encountered; a 390k charging resistor for this capacitor to allow rapid rise times for the control voltage; and the use of a 4.7uF capacitor on pin 2 of the IC to give the fast attack and decay characteristic essential for this application.

The overall gain of the system is unity requiring an input of approx. 300 mV for satisfactory operation.

Sw2 allows the circuit to be used purely as a volume compressor, the 4.7uF capacitor at pin 2 of the IC being replaced by a 15uF to give a fast attack and slow decay characteristic.

Layout is not critical, the prototype being built on "Veroboard." The unit has been in operation for about one year and gives excellent noise reduction with tapes and also eliminates most surface noise from discs.

REFERENCES

(1) Goodell, J. D. and Michel, B.M.H. Auditory perception. Electronics, 142, (July, 1946). Cited by Markus, J. and Zeluff, V. Handbook of Industrial Electronic Circuits, McGraw-Hill, London, 1951.
(2) Simpson, L. An IC volume compressor for recorders, PA and transmitters. Electronics Australia, February, 1970.

* Raymond Purves Research Laboratories, Royal North Shore Hospital, St Leonards, NSW 2065.

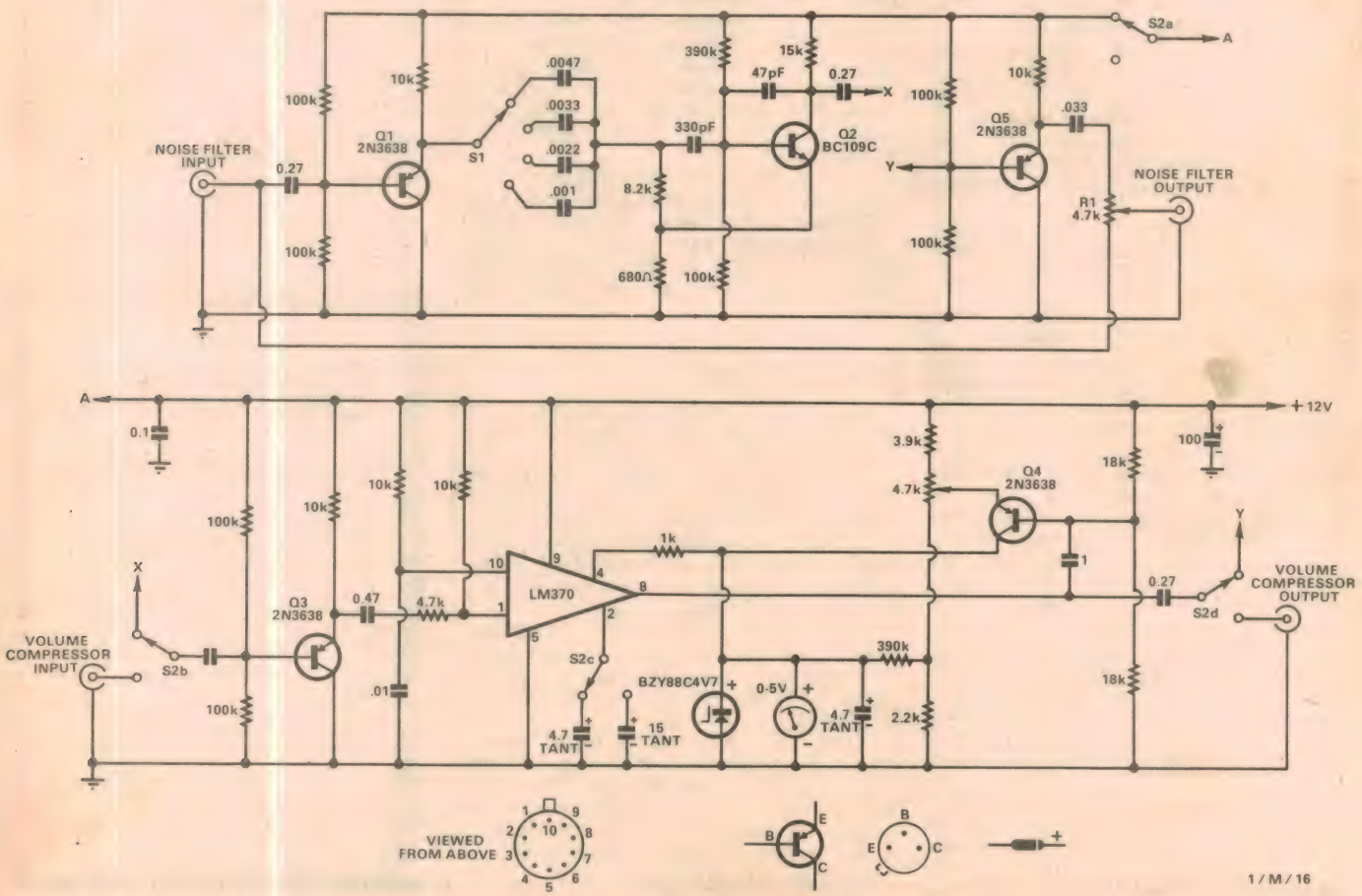


*Figure above shows the author's circuit which employs 5 transistors and 1 IC. Layout is not critical, the prototype being built on veroboard.*

# jaycar

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This four page catalogue is intended as an addition to our advertisement in the August edition of this magazine. Copies of those four pages are available on request.

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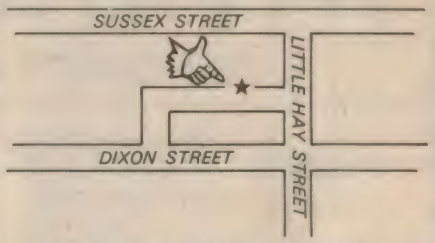


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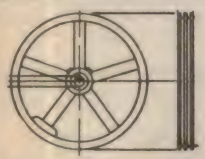

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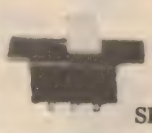
As above
SE-120: 3P (SPDT) 21c



6P (DPDT) 33c
SE-212

6P (DPDT) 45c
SE220

6P (DPDT) 24c
SE-230

### SLIDE SWITCH

(3P3T) 53c
SE-330

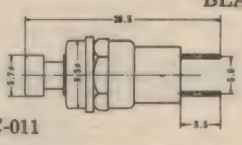
### SEE-SAW SWITCHES

2P (SPST) 34c
SI-110

2P (SPST) 52c
SI-111

6P (DPDT) 53c
SI-220

MINIATURE PUSH BUTTON SWITCH: RED BLACK



SC-011

INSTANTANEOUS ON
32c

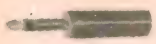
### SLIDE SWITCH

SE-530
(5P3T) 65c

# JAYCAR COMPONENTS

PO BOX 39
HAYMARKET
NSW 2000

## HIGH QUALITY METAL AUDIO CONNECTORS & ADAPTORS



KW-010 — MINIATURE PLUG to RCA PIN JACK: (P 3.5 to J RCA) 41c

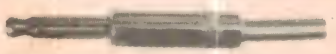
KW-020 — P6.3 to P3.5 — 54c
PHONE PLUG to MINIATURE PLUG

KW-030 — (P 6.3 to J 3.5) — 48c
PHONE PLUG to MINIATURE JACK

KW-040 — (P 3.5 to J 6.3) — 48c
MINIATURE PLUG to PHONE JACK

KW-050 — (P.RCA to J 3.5) — 48c
RCA PIN PLUG to MINIATURE JACK

KW-060 — (P. RCA to J 6.3) — 48c
RCA PIN PLUG to PHONE JACK



KW-070 — (P. 6.3) — 63c
CABLE PHONE PLUG

### PHONE PLUGS

(AP 301) — POWER PLUG MATES WITH AJ302 — 19c

(AP 311) — 3.5mm PLUG MATES WITH AJ 311 — 15c

AP 320 — STANDARD PLUG — 30c

| | | |
|---|---|---|
| AP325 | AS ABOVE BUT ALL METAL | 51c |
| AP-330 | STEREO PLUG 3 CONDUCTOR | 55c |
| AP-335 | AS ABOVE BUT ALL METAL | 60c |

KW-080 — 72c
MIKE CONNECTOR to RCA PIN JACK

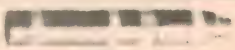
KW-090 — KW-091 — 090-58c 091-51c
MIKE CONNECTOR

KW-100 — 72c
(MIKE CON to J 6.3)
MIKE CONNECTOR to PHONE JACK

KW110 — 54c
PHONE PLUG to PHONE PLUG (6.3 to 6.3)

KW-130 — (6.3 JRCA) — 72c
PHONE PLUG to RCA PIN JACK

KW-140 — (J 6.3 to J 6.3) — 72c
PHONE JACK to PHONE JACK



KW-150 — (J 6.3 to J 3.5) — 61c
PHONE JACK to MINIATURE JACK

### PHONE JACKS

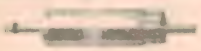
AJ-302 — POWER SOCKET MATES WITH AP-301 — 26c

AJ-311 — 3.5mm JACK MATES WITH AP-311 — 13c

| | |
|---|---|
| AJ-339 30c | OPEN CIRCUIT JACK MATES WITH AP-320 OR AP-325 |
| AJ-319 33c | CLOSED CIRCUIT JACK MATES WITH AP-320 OR AP-325 |
| AJ-331 48c | OPEN CIRCUIT JACK MATES WITH AP-330 OR AP-335 |
| AJ-332 67c | CLOSED CIRUIT JACK MATES WITH AP-330 OR AP-335 |

KW-160 — 54c
RCA PIN JACK to RCA PIN JACK:

KW-170 — 3.5 to 3.5 — 54c
MINIATURE PLUG to PLUG

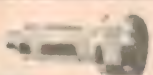


KW-180 — (P 3.5 to P RCA) — 54c
MINIATURE PLUG to RCA PIN PLUG

KW-190 — (J 3.5 to J 3.5) — 61c
MINIATURE JACK to JACK

KW-200 — (P 2.5 to J 3.5) — 48c
SUB-MINIATURE PLUG to JACK

KW-210 — 54c
RCA PIN PLUG to RCA PIN PLUG



KW 220 — (J 3.5 to MIKE CON.) — 65c
MINIATURE JACK to MIKE CONNECTOR

EARPHONES
Magnetic Crystal

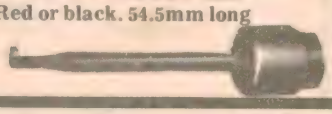
EE-101 — 50c ea
20 — 1.5KHz
97dB at 1KHz
200mW

EE-201 — 65c ea
Capacity: 1,400PF
Sensitivity: 95dB

MICROPHONE UNIT — $1.80 ea

Impedance: 200 Ω or 500 Ω
Dimensions: 20 Φ X 15
Weight: 14.2g, 16g

JAYCAR I.C. TEST CLIP
Red or black. 54.5mm long
55c ea.



# JAYCAR COMPONENTS

PO BOX 39
HAYMARKET
NSW 2000.

## DIN PLUGS

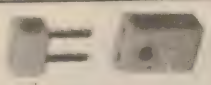
AP-920: 2P — 34c
AP-935: 3P — 41c
AP-945: 4P — 54c
AP-955: 5P — 55c
AP-965: 6P — 65c

## DIN SOCKETS

AS-920: 2P — 22c
AS-930: 3P — 27c
AS-940: 4P — 28c
AS-950: 5P — 30c
AS-960: 6P — 32c

DIN LINE SOCKET
AS-956 58c
Mates with AP-955

## TV Feeder Connectors



AR-500 20c

AR-510 unpolarised 21c
AR-512 polarised 22c

## 2 PIN AC SOCKETS

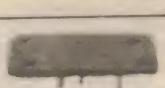
AR-602 socket 15c
AP-602 plug 36c

## VALVE SOCKETS

AS-401-9 pin 12c
AS-402-7 pin 10c

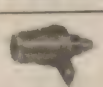
AS-420 COMPACTRON SOCKET 32c

AS-430 G. T. SOCKET 31c



AS-451 15c
TRANSISTOR SOCKET

## RCA PIN JACK



AT-700 19c

## CONNECTORS

4 PIN CONNECTOR PLUG
10c
AP-040

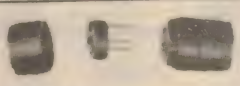
4 PIN CONNECTOR SOCKET
10c
AS-040

## Plug And Socket Sets

SCREW MOUNT.
AR-030, 3 conductor 46c
AR-040, 4 conductor 51c

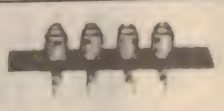
BRACKET MOUNTING
AR-130, 3 conductor 44c
AR-140, 4 conductor 48c

AR-170 (7 way) 59c
AR-190 (9 way) 64c



AR-430 (3 pin) 59c
AR-440 (4 pin) 66c

## RCA Pin And Jack Strips

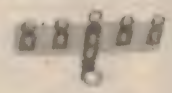


AT-630, 1 pin — 35c
AT-631, 2 pin — 40c
AT-634, 4 pin — 75c
AT-636, 6 pin — $1.00

## Screw Terminal Strips

2 pin — AT 522 — 30c
3 pin — AT 523 — 33c
4 pin — AT 524 — 44c
5 pin — AT 525 — 47c
6 pin — AT 526 — 66c

## Terminal Earth Strips

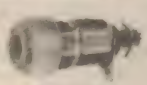


MINIATURE
3 way 10c
5 way (as above) 14c
8 way 23c

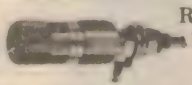
STANDARD
3 way 8c
5 way 14c
8 way 24c

## BINDING POSTS

Red, Black
10 M / M
6c
AE-101



Red, Black
12 M / M
19c
AE-110
Captive or Free Head



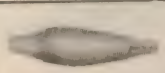
Red, Black
16 M / M
40c
AE-120

BANANA PLUG

Red, Black
13c
AY-301

Tip Jack for above
Red, Black
14c
AY-351

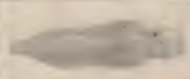
## ALLIGATOR GRIPS



Red, Black.

AY-420 (31mm) — 7c
AY-430 (45mm) — 8c
AY-440 (70mm) — 10c

## BATTERY CLIP



Red, Black

AY-451 (50mm) — 18c
AY-452 (60mm) — 24c
AY-453 (90mm) — 30c
AY-454 (90mm H.D.) — 40c

## ARROW TYPE TIP

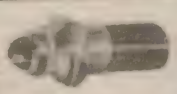
Red, Black
For Posts
AY-201 12c

## BEZELS

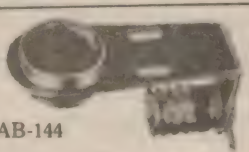
NEON
Red, Green, Amber, Clear
AB-002 43c

Red, Green, Amber
with 6.3v Globe
AB-101 50c

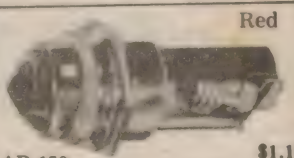
Red, Green, Amber
with 6.3V Globe
AB-111 50c



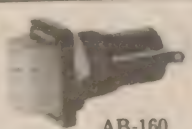
Red, Green, Amber
without globe
AB-120 51c



Red
AB-144 74c



Red
AB-150 $1.15



Red, White, Green
44c
AB-160

## LM381

**Alternative for E.T.I. Master Mixer**

Complete kit of parts to enable you to complete the project includes P.C. board, 2 LM301, 4 ceramic caps, 4 resistors and circuit diagram.

KIT $6.00 EA.

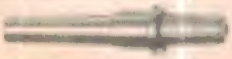
# JAYCAR COMPONENTS

P.O. BOX 39
HAYMARKET
N.S.W. 2000

## FUSE HOLDERS

AH 601 STANDARD 8c
TF 758 MINIATURE 8c

AH 720 STANDARD 45c
AH 750 MINIATURE 42c



AH-730
IN LINE TYPE 16c

## FUSES

STANDARD 3AG 12cents ea.
100MA to 10A

MINIATURE TYPE
20mm x 5mm 12 cents
.5A 1A 2A 3Amp ea.

NYLON CABLE TIES
1/10" wide x
4½" long
4 cents each

## Cord Grip Grommets

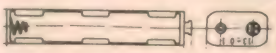
TYPE A — Suitable for 3 core flex 9c

TYPE B — Suitable for figure 8 types 7c

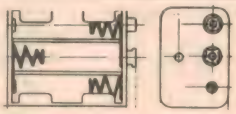
## BATTERY CASES UM3

AH-902 UM 3 x 2 33c

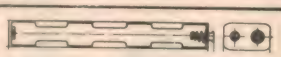
AH-900 UM 3 x 4 43c



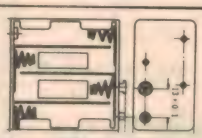
AH-904 UM 3 x 4 39c



AH-906 UM 3 x 6 65c

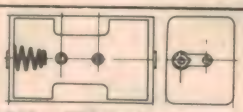


AH-908 UM 3 x 6 63c

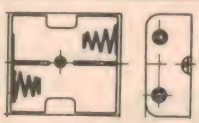


AH 909 UM 3 x 8 86c

## BATTERY CASES UM2

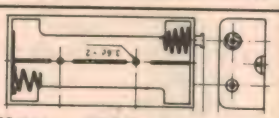


AH-910 UM 2 x 1 43c



AH-912 UM2 x 2 60c

## BATTERY CASES UM2

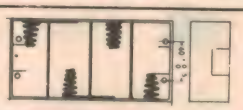


AH-914 UM 2 x 4 83c

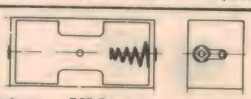
AH-916 UM 2 x 4 79c

## BATTERY CASES UM1

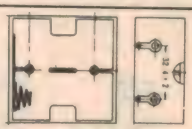
AH-922 UM 1 x 4 $1.40



AH-924 UM x 1 x 4 $1.40

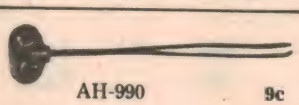


AH-918 UM 1 x 1 45c



AH-920 UM 1 x 2 71c

## BATTERY-SNAPS



AH-990 9c

AH-991 9c

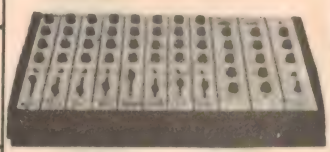
## PLAYMASTER 138 AM TUNER

- Wide bandwidth or high sensitivity.
- Signal strength and tuning meter.
- Whistle filter.

**Complete kit only $62.00.**

**Please add $1.50 p&p.**

## NOW THE NEW E.T.I. 414 MASTER MIXER



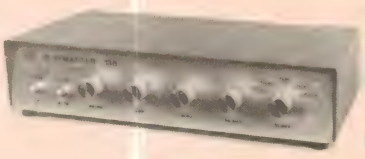
### AVAILABLE NOW IN A JAYCAR KIT

Complete kit of parts $188.00 p&p $2; Kit of parts less national semis $153.00 p&p $2.
Kit of parts for one mixer / equalizer $19.10 20c p&p (including semis).
Parts for pre amp and tone controls for two channels $21.00 p&p 20c including semis.
Parts for power supply board including semis $26.25 p&p 20c.
Metal work $9.90 p&p $1.
Front panels $3.40 each p&p 20c.
Timber case $6.75 p&p $1.

**All coils prewound.**
**Kit wired and tested $30 extra.**

## PLAYMASTER 136 STEREO AMPLIFIER

*(As featured in E.A. Dec '72)*



ONLY
**$55.00**
plus $1.50 p.p.

FEATURES • 13 Watts R.M.S. per channel • Frequency Response 20Hz to 120 kHz • Equalisation for magnetic pick-up • Inbuilt simulated Quad. facilities. • Kit of parts excluding Fairchild Special Offer Transistors.

## E.T.I. 413 100 WATT GUITAR AMPLIFIER

*(as featured in Electronics Today Dec '72)*

FEATURES • Robust and compact • Frequency response 20Hz to 150kHz ± 3dB • Total distortion .5% at 80 watts.
Complete kit of parts

ONLY
**$65.00**
Plus $2.00 P. & P.

# THE SERVICEMAN

## When test equipment deceives

As with any job, a serviceman must know how to use his tools of trade. And this means not only pliers, screwdrivers and soldering iron; but also meters, signal generators, CROs and similar test and measuring devices. None of these is perfect and knowing the limitations is a vital part of the job.

Ever since the time a serviceman first tried to read the voltage on a valve's screen grid with a 1000 ohms / V meter, those of us who followed have, been similarly deceived from time to time, by the very piece of test equipment which was supposed to help us. While not many would be trapped these days by the loading of a meter, some of the more elaborate pieces of equipment can produce their own special tricks. In fact, I wonder whether there is any limit to this problem since, apparently, any piece of test equipment can effect the unit under test if the circumstances are suitable.

A letter recently to hand from a country serviceman makes this point very well indeed. Here is his story.

It was almost knock-off time, so I decided to make the last job for the day an easy one — or so I thought. It was a TV set, a few years old, but of reliable make, and one with which I was quite familiar. The fault seemed quite straightforward; sound but no raster.

A preliminary check showed some activity in the horizontal output stage and a once-over with the VTVM showed all voltages about normal, although a little on the high side if anything. This was to prove significant later.

For jobs like this I like to use a television set analyser; a most useful piece of equipment which can not only check the behaviour of a nominated section, but may often be patched in to function in place of it, thereby putting the question beyond doubt. Such a facility is most valuable where, as in a line output stage, there are a number of interdependent functions, making it difficult to pinpoint the weak link in the chain.

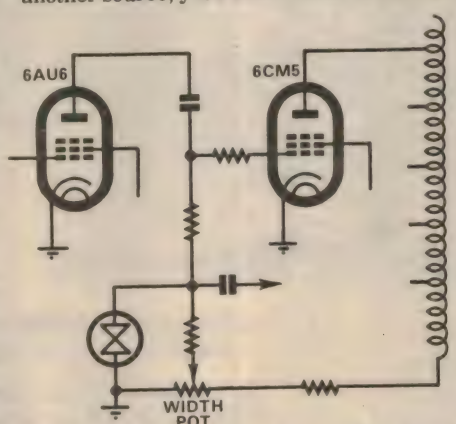
So I removed the plate lead from the line output valve (6CM5) and patched it into the "Horizontal Plate Drive" jack of the analyser. The analyser was now providing drive for the line output transformer and up came a raster on the set's picture tube, indicating that the tube, line output transformer, yoke, and all associated components were in order. So far, so good.

Next I restored the 6CM5 plate lead and patched the grid (pin 5) of the 6CM5 to a "Horizontal Grid Drive" outlet on the analyser. Again I obtained a raster. So far, so good, again.

But when I transferred the analyser drive from the 6CM5 grid to the plate of the line oscillator (6AU6) there was no raster. There were only two components between the 6AU6 plate and the 6CM5 grid; a coupling capacitor and a 1000 ohm stopper resistor. It did not take me long to establish that both were intact. "What's going on," I thought, "I have normal grid bias, and I am applying normal drive via components which test OK. So what gives?"

At this point I had a mild influx of customers. By the time I had attended to them, it was past closing time. I decided to give it a rest until the morning.

Next morning I attacked the horizontal oscillator with the CRO, only to find that it was delivering a waveform of correct frequency, amplitude, and shape. Which took me back to square one; I had normal oscillator drive, an output stage which behaved normally when driven from another source, yet I didn't seem to be able




*Skeleton circuit of the line oscillator and output section. The mere presence of a test circuit between the 6CM5 grid and chassis was sufficient to restore operation.*

to get the two together. Fairly obviously, the trouble was in the coupling network between the two stages.

Just to confirm the situation, I once again fed signal from the analyser into the grid circuit of the 6CM5. Up came the raster as before and I was contemplating what to do next when I happened to glance at the panel of the analyser and realised that its function switch was still in the "Standby" position. I wasn't feeding signal from it into the line output stage at all; the stage was being driven by its own oscillator. Yet when I disconnected the analyser, the raster vanished.

Realising that it was the mere presence of the analyser connection which made the set work I reached for the circuit belonging to the analyser. Sure enough, there was a 1M resistor from the "Horizontal Grid Drive" outlet to chassis and which was, therefore, effectively connected between the 6CM5 grid and chassis.

Thus alerted, I measured from the 6CM5 grid to chassis. It was open circuit. The grid circuit is a fairly conventional arrangement, involving a feedback network with a width pot as part of it. And that's where the trouble was; the width pot. A measurement between wiper and element terminals revealed an open circuit, but one which came good immediately I moved the shaft. An application of some aerosol cleaning fluid and a couple of brisk turns of shaft and I had a raster. It was only necessary to reset the width and the job was done.

I'm not quite sure why the open grid circuit had the effect that it did, but I think that it is a fair bet that the heavy drive normally associated with the grid of a line output stage would quickly develop excessive bias, thus effectively putting the 6CM5 out of action.

Several weeks later I had a house call to another TV set having similar symptoms. When I attempted to measure the grid bias on the 6CM5 using a small 20,000 ohms / V multimeter, I immediately had a raster. As you have probably guessed, it was the same trouble and it responded to the same cure.

I thought, "If only I had used a multimeter on the first jobs instead of the VTVM, I would have saved a lot of time.

"Ah well . . ."

Well, that's my colleague's story and I don't think there is a great deal I need to add. Doubtless he will be on guard in future — in fact the experience has already paid off once — and, thanks to his letter, yours truly and you who read these notes should equally be on guard.

From my own workshop the most interesting story this month has nothing to do with radio or TV sets; it is yet another story of what happens when the home handyman dabbles with mains operated devices. Maybe I have something against this type — or maybe it's just that, in this business, I come a lot closer to them; or their aftermath!

This example concerns an electric blanket. A customer walked into the shop and plonked the blanket on the table. Actually, she is a personal friend — and so is her husband.

The blanket belonged to the husband's mother, who lives in one of the church retirement villages on Sydney's North Shore. He had been visiting his mother one day, when she asked him if he would help her put the electric blanket on her bed. Naturally, he agreed.

On looking at the switch, he noticed that it was cracked and bound with sticky tape. "You can't use that, Mum. It's unsafe. I'll buy a new switch and put it on for you."

After quite a deal of trouble, he bought a new switch, and proceeded to fit it, copying the one he was removing. He did quite a workman-like job too — wires neatly twisted and anchored, etc.

Came the first cold night of winter, and mother switched on her electric blanket. Bang! Out went the lights.

She didn't just blow her fuse, because a number of units (a whole floor, I think) are on the same fuse. She plunged them all into blackness.

(That struck me as being a bit odd — lights and power on the same circuit. But anyway . . .)

Being an average LOL (Little Old Lady) who can be a bit vague about things at times, she apparently did not associate the switching on of the blanket with the light failure. If she thought about it all she

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probably wrote it off as coincidence. In any case, someone called the council and an electrician was despatched to restore power.

In the meantime, she turned the blanket off. She realised that there was no power and, if she left it turned on, the blanket would heat during the night. Typical of many, she prefers to use the blanket only to warm the bed before retiring.

Therefore, by the time power was restored, the cause had been removed, and the council workman apparently accepted it as "one of those things", without being able to find a cause.

Next night, another nippy one, she once again turned on the electric blanket. Bang! Out went the lights. Even for a vague LOL, this was a bit fishy!

This time, she deliberately removed the plug from the wall socket, and waited till morning. (Council once again repaired the fuse, without knowing the cause.) As soon as she could, she rang her daughter-in-law. "I'm not sure," she said, "but I think my blanket is blowing the lights."

Which is where I came into the picture. "My husband put on a new switch for mum, but it blows the lights every time she turns it on."

I reached for my multimeter and connected it across the live pins on the power plug. The switch had been left in one of the two "off" positions with which these switches are fitted; the one adjacent to position "3" as it happened. The meter showed open circuit. I switched to position "3" and it read 2000 ohms; position "2" showed open circuit; position "1" showed open circuit.

I was a bit puzzled by now. While the readings so far were not very logical, there was no sign of a short circuit. Unless it was in the remaining "off" position — which didn't seem likely — I had a first class mystery on my hands. I switched to the "off" position. Wham! Dead short. So that solved that part of the puzzle.

I took the cover off and checked the inside. It was a conventional arrangement, as shown in the diagram. Two screw terminals at each end, with another terminal slightly offset from the centre of the switch arc. I more or less knew instinctively what he had done.

He had transferred the two wire mains input to the two output terminals, and had two of the three output leads on the input, with the common lead actually going to the correct place! (Electric blankets have two elements and, by switching, these can be placed in series for lowest heat, one element only for medium heat, and both elements in parallel for full heat.)

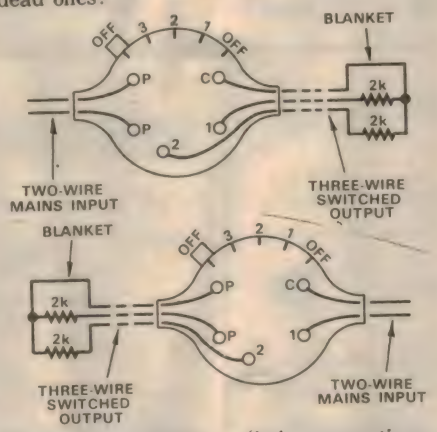
Don't ask me why the transposed connections had the effect they did. To answer that I would have to analyse the entire switching mechanism, and I simply couldn't justify the time to do that.

It didn't take long to put the connections where they should be — and after briefly checking that no tragedy had befallen the switch I gave it back to her. I also gave a thinly veiled hint that he would be lucky if he didn't kill someone if he persisted in tampering with things he knew nothing about.

Fortunately, there is little the blanket could do except blow fuses. It almost certainly could not kill anyone! But imagine the same bloke fiddling with a three pin plug on a portable drill.

He is typical of many home handymen — willing to "avago" at anything, with no thought of danger. They say experience is the best teacher — in the case of mains appliances "they", whoever they may be, are wrong!

As I said, I might have something against home handymen — but I don't think so. Rather, I would prefer live customers to dead ones!




*Upper: The correct switch connections. Lower: As our handyman made them.*

And, in lighter vein, here is another story from a country reader.

*Dear Serviceman,*

*This article may be far from informative, as I feel that it is a unique problem, but I hope that you find it amusing.*

*Newly arrived from the city, to a potato growing area, I occasioned upon a Philips TV chassis that had been dropped, resulting in a hair line fracture in the copper pattern to the video amplifier cathode.*

*The farm-hand who owned it found that by applying pressure to the circuit board, a picture could be restored. Using typical country ingenuity, he had wedged something in between the circuit board and plastic back cover, restoring performance until he could bring it into town.*

*The set was brought to me in this condition, minus the temporary repair. After 10 mins the initial problem was found and duly repaired. However, the resulting picture was anything but desirable, suffering from lack of horizontal sync, vertical sync, intermittent horizontal oscillator, distorted sound and no AGC. I sent a rather despondent customer away, assuring him that the problems could be resolved quickly.*

*Some 30 hours later, all that I had assessed was that there was 5k to 10k resistance between every pin of every valve on that particular section of the board. In desperation I contacted the customer and after some prodding he sheepishly revealed the exact nature of his temporary repair.*

*There being an abundance of spuds, it was found that a suitable "2 ouncer," rammed between the circuit board and the plastic back-cover, approximately half way up the chassis, would "do the trick." After the spud had shrivelled a second one was unsuccessful in "getting it going again."*

*Now all became clear — the chemical decomposition of the spud had formed a film of low resistance "gluk" invisible to the eye. After 3 applications of methylated spirit to both sides of the board and replacing the valve sockets in the affected area it was then a simple matter to replace damaged components. Needless to say, my labour costs were lost, and any more of this sort of thing and I will go back to the city.*

# CIRCUIT & DESIGN IDEAS

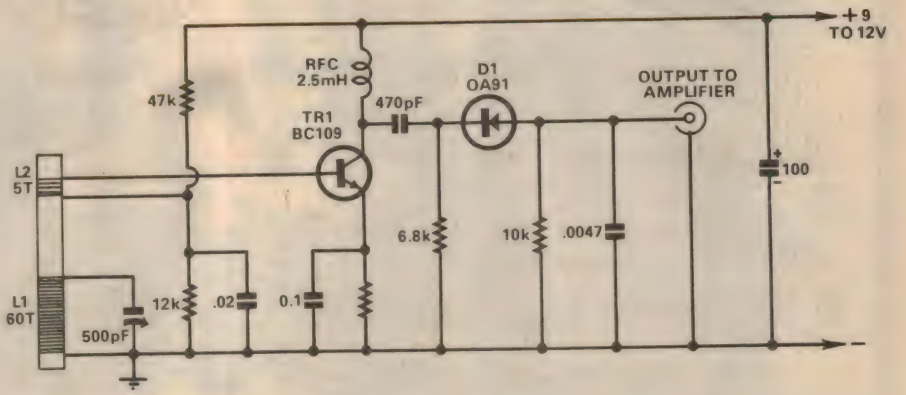
Interesting circuit ideas and design notes selected by the Editor from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Contributions to this section are always welcome.

## Medium Wave Radio Tuner

This circuit consists simply of an RF amplifier (TR1) and diode detector. It tunes over the medium wave band only and on test in the London area received both local transmissions and at sufficient strength to provide around 100mV of audio signal at the output. This is a suitable level for feeding direct to a tape recorder or amplifier.

The tuning section consists of a ferrite rod and tuning coils so no external aerial is required. The tuning capacitor (500pF) may be an airspaced type or one of the small mica types. The RF amplifier (TR1) is a BC109 and the signal output from this is taken directly to the diode detector (D1).

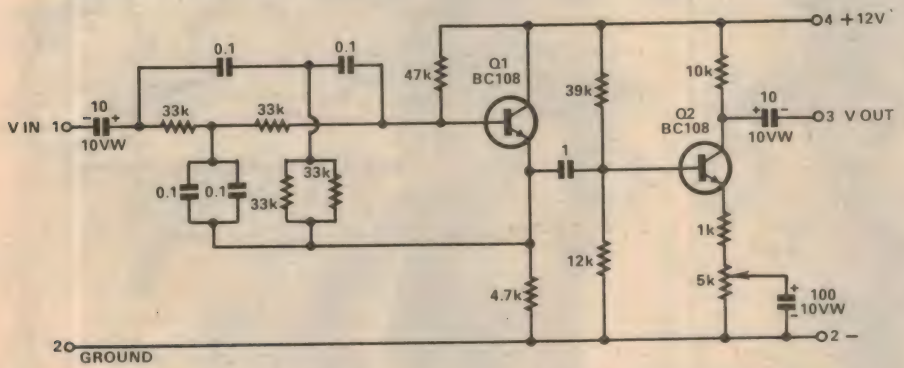
The ferrite rod should be at least 6in long and 3/8in in diameter. The coil formers can be made from cardboard rolled and glued to fit over the ferrite rod and each coil is wound with 30SWG (28B&S) enamelled wire. The small coil (L2) should normally be at one end of the ferrite rod and the tuning coil (L1) at the other. However, moving L2 nearer to L1 will increase sensitivity but will reduce selectivity and vice versa. The tuner can be run from a 9V battery and consumes only 1 to 1.5mA but extra sensitivity will be obtained with a 12V battery. Note that the transistor is an NPN type and therefore operates from a positive supply rail. Do not use a metal case to house the tuner.




(By F. C. Judd, in "Audio".)

Editorial note: No value is given for the BC109 emitter resistor but we suggest that you try 1k initially. A slight variation either way may be tried to see if this improves results.

## A 50Hz Hum Eliminator




Whenever 50Hz hum is a problem in the laboratory, I have found the hum eliminator which is shown in the diagram to be very useful. There is really nothing new in the circuit. It uses a twin-T network which is a narrow band elimination filter centred on 50Hz, and which gives infinite attenuation at 50Hz. To ensure correct operation, the resistors and capacitors in the twin-T network are selected as close as possible to the wanted values from a handful of components. On the other hand close tolerance, 1pc resistors and 5pc capacitors may be used. Q1 is an emitter follower with high input impedance and a voltage gain of slightly less than unity.. Q2 is a series current feedback amplifier. The feedback is determined by the unbypassed resistor in the emitter circuit of Q2. The circuit operates from a 12 volt source.

The hum eliminator may be mounted in a small instrument case and provided with terminals. Terminals 1 and 2 are the input, 3 and 2 the output, with 2 and 4 the DC power supply. The voltage gain of this circuit may be adjusted by feeding a 400Hz signal of known amplitude, say 1 volt, at the terminals 1 and 2 and adjusting the 5k pot to give a signal of say 2 volts at terminals 3 and 2, thus giving a voltage gain of 2. The voltage gain could be set anywhere between about 2 and 10.

(By Mr N. Kandasamy, PO Box 334, Broken Hill, NSW 2880.)

## Zener Diode Cathode Bias

In designing power amplifiers it is often convenient to obtain operating bias from a cathode resistor. However, the variation in the DC component in class AB1, AB2, or B amplifiers causes changes in the bias which generates distortion and is undesirable in high performance systems.

This distortion may be eliminated by using a zener diode in the cathode lead to supply bias. In this case the bias is constant as long as the cathode current does not go below the minimum current for good zener action or above the current that would damage the zener diode. With this arrangement, however, the zener diode must handle the total cathode current which may be substantial and would require a large and expensive zener diode.

The current that flows through the diode can be reduced by shunting the zener diode with a bypass resistor. If the resistor is properly proportioned in relation to the bias voltage and cathode current, most of the DC component of cathode current will flow through the resistor with just enough flowing through the zener diode to "keep it alive".

The zener diode will hold the bias voltage constant; the current through the resistor therefore will also be constant and any

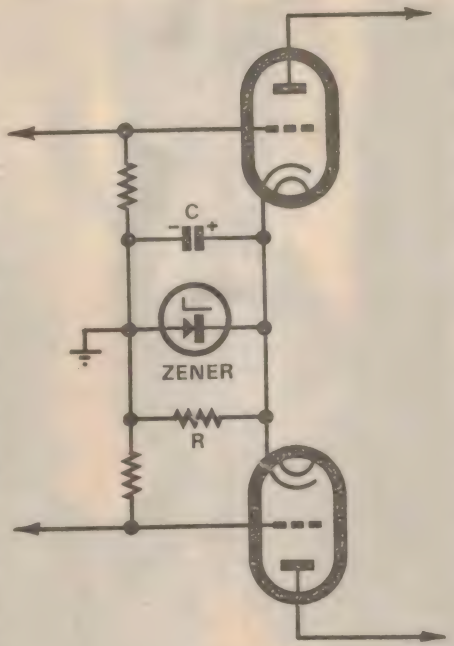
increase in the current, such as caused by a signal, will pass through the zener diode. Since the diode internal impedance is relatively low, variations in the bias will be small.

The value of resistor needed is: R is equal to Ec / (Imin — Iz min), where: R is the value of bypass resistor, Ec is desired bias, Imin is minimum value of cathode or source current, Iz min is minimum value of zener diode current.

The peak power dissipated by the diode is: Pc is equal to Ec (Iz min + delta I), where: delta I is the signal-to-no-signal change in cathode current and the other symbols are as above.

The actual power rating required of the diode will depend on the peak-to-RMS current ratio for the type of signal being transmitted and may be considerably less than that indicated above, especially where the signal consists of speech.

The saving in diode power dissipation due to the resistor is equal to the power dissipated by the resistor and is: Pr is equal to Ec (Imin — Iz min). It is apparent that the advantage of a bypass resistor will be greater in situations with a large DC component and a small variable component, such as class AB1 amplifiers, and less where the reverse is true, such as class B amplifiers.




The use of a zener diode bypass resistor is also convenient in the case of low frequency AC or DC amplifiers, both power and voltage, where a cathode resistor can not be adequately bypassed, and a substantial reduction in stage gain would take place if a bias resistor were used.

Placing a bypass capacitor across the zener diode / resistor combination will maintain a low impedance at high frequencies where the internal impedance of the zener diode tends to increase. Because the capacitor need not be effective at low frequencies, it can be considerably smaller than is usually used.

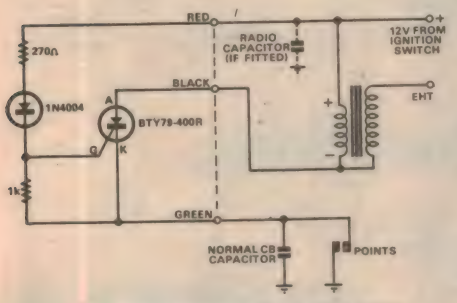
In brief, by properly proportioning the components, the resistor will carry most of the DC component of cathode current, while the zener diode carries the remainder of the DC component plus the low frequency AC component, and the bypass capacitor carries the high frequency component. Although a push-pull circuit is shown, the use of zener diodes for cathode biasing is equally applicable to any other situation where it is desired to develop a constant voltage by passing a current with a large DC component and a variable component through a resistor. This can result in smaller and more economical components in all positions.

This circuit should not be used for transistor amplifiers since transistors are current-operated and not voltage-operated devices.

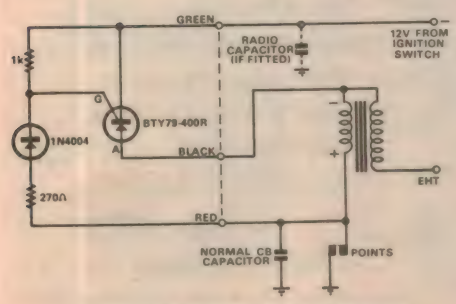
(By John J. Nagle, K4KJ, in "CQ".)

## SCR Ignition Booster

This circuit was evolved in an attempt to "go one better" than the Dwell Extender. The idea leading to this circuit was basically an attempt to increase the coil output voltage by electronically disconnecting the CB capacitor from the coil circuit, some microseconds after the points open. This causes a faster rate of collapse of the magnetic field, thus leading to a higher output voltage. A timing light shows a small advance in the spark timing.




SCR IGNITION BOOSTER FOR 12V NEGATIVE CHASSIS




SCR IGNITION BOOSTER FOR 12V POSITIVE CHASSIS

Over 30 of these units have been built and fitted to cars of friends. The units were built in various forms but most of them were built into small aluminium boxes. In some instances the SCR was insulated from the case and in others the whole unit was mounted on perspex. During installation, it was found to be convenient to use a piece of insulating board, such as bakelite, to provide an extra terminal near the coil to make a neat termination for the distributor point lead.

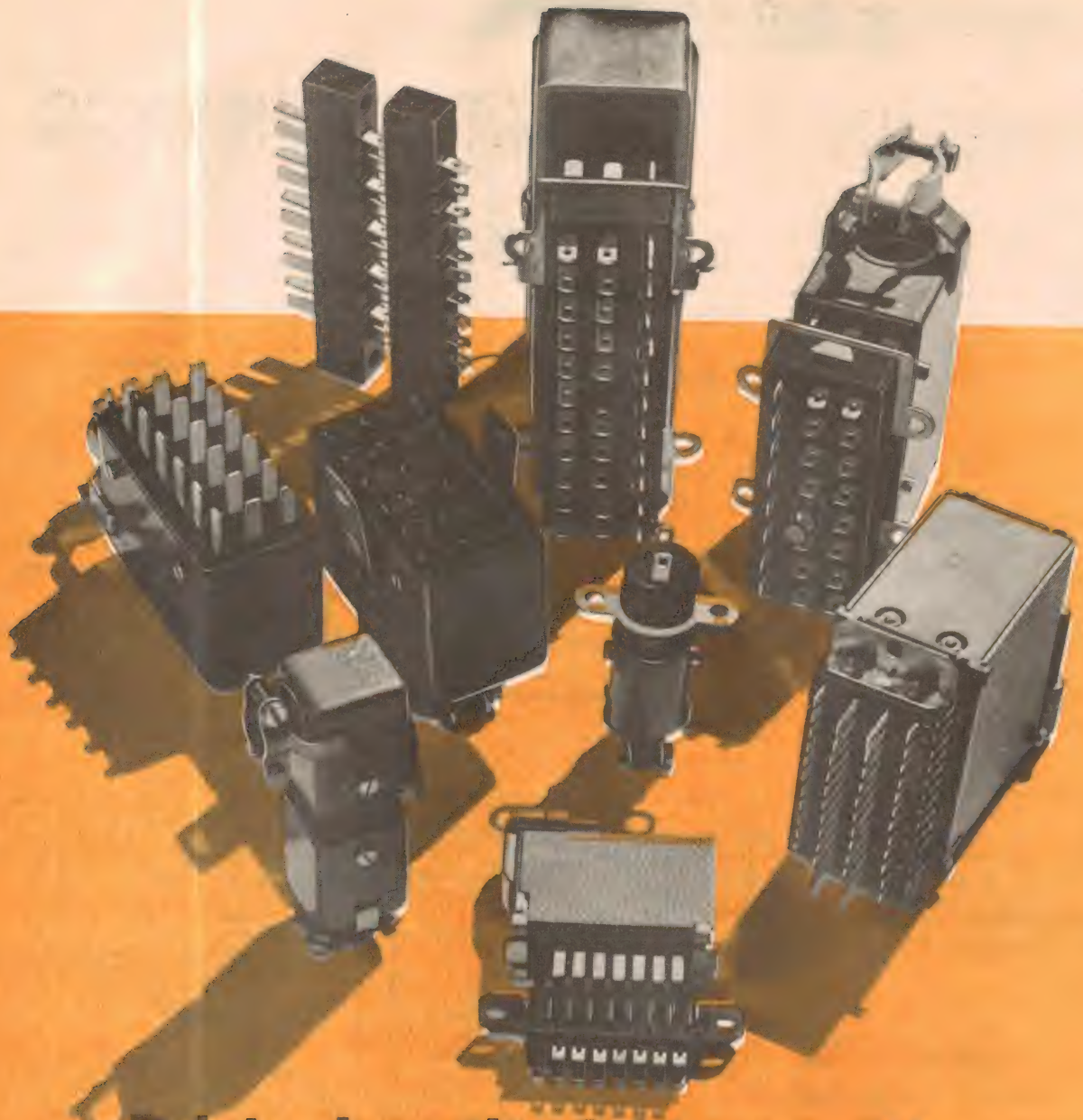
The performance of this circuit was found to be superior to that of the Dwell Extender but not quite as good as a CDI system. However, the SCR Booster is considerably less complex and is cheaper. I have noticed a worthwhile improvement in acceleration and idling smoothness. Exhaust pipe deposits usually changed to a dry slate colour. Petrol consumption was also reduced but some drivers making use of the extra "zippiness" available tended to offset the improved petrol consumption.

It appears that cars that benefit most from this circuit include Falcons, and Holdens from 1964 models.

I am of the opinion that there would be very little advantage in fitting electronic ignition to high performance engines that utilise a smaller than average spark gap.

(By Mr A. Kethel, Telephone Exchange, Thomas Street, Chatswood, NSW 2067.)

Editorial note: The validity of this scheme may be open to debate but we consider that it is of sufficient interest to warrant further investigation.



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AC87

# Television—Modern Systems

Basic concepts. Scanning. Electronic scanning. Deflection systems. Interlaced scanning. Synchronisation. Vertical and horizontal pulses. Sync separation. Camera tubes. Iconoscope, Image Orthicon, Vidicon, Plumbicon. TV standards. Number of elemental areas. Bandwidth.

Of necessity, the historical discussion in the two previous chapters touched on some technical aspects of various systems as they were tried and, in many cases, discarded. Inevitably, the reader will have gained a smattering of the basic principles on which television is based and of some of the details, though hardly enough to provide a useful grounding for further studies.

In this chapter, and the one to follow, we plan to discuss basic principles and technicalities in greater depth, particularly in regard to modern systems. Initially, some apparent duplication will be inevitable, being necessary to preserve continuity of explanation and facilitate in-depth explanations.

Perhaps the best place to start is with the TV image itself — the form it takes and the reasons why the eye is able to accept it.

Consider the eye first. It has two characteristics which make TV possible; both already exploited in other spheres. Probably the best known is "persistence of vision" — the fact that the eye retains the image of a scene for about 1/16 second after the scene itself has been removed.

It is this fact that makes motion pictures possible in the form we know them, since it enables a series of still pictures, presented in quick succession, to appear as a continuous picture, with small differences between them appearing as movement. In practice, motion pictures use anything from 16 pictures (frames) per second for amateur systems to 30 frames per second for some of the more elaborate wide screen theatre systems. More conventional theatre systems use 24 frames per second.

The other characteristic which we credit, in broad terms, to the eye is its ability to accept, as a complete picture, an image which is, in reality, composed of a number of small discrete areas. A classic example is the "half tone" reproduction of a photograph in a newspaper or magazine. Since the printer has no way of presenting actual tones between the white of the paper and the black of the ink, he resorts to the trick of breaking grey areas into patterns of tiny black dots, their size relative to the surrounding white areas determining the shade of grey. The eye accepts this as a complete picture.

In part, this reaction is undoubtedly due to the simple physiological fact that the eye cannot resolve detail below a certain minimum size. Thus if we view any reproduction at a sufficient distance the eye simply cannot resolve the defects and the viewer is therefore not conscious of them.

However, this is not a complete explanation. The fact is that the impression of a recognisable image, complete with varying shades of grey, is retained even when the dot structure is coarse enough to be clearly visible. This suggests that there is a psychological basis for this phenomenon, whereby the mind "fills in" the missing detail.

In any case, and whatever the reasons, the fact remains that the "eye" is remarkably accommodating in this regard. It is this fact that makes the TV image as acceptable as it is.

Now let us consider how the TV image is constructed.

As the very first experimenters realised, in order to transmit an image from one place to another it is necessary to divide the image into a large number of discrete areas (much like the dots in the newspaper reproduction discussed above), measure the light value of each area, and convert this to an electrical signal suitable for transmission to the distant point. At the distant point the process is reversed. The signal is used to generate light which has a similar value to that of the original image area it represents.

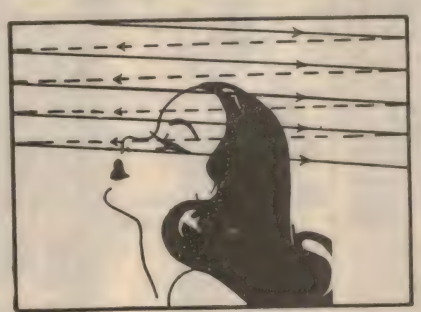

*Fig 1. An elementary scanning pattern. The solid lines represent the scanning movement, the dotted lines the retrace action. The distance between the lines is exaggerated to simplify the drawing.*

Assuming that we make the discrete areas small enough and re-assemble them all in the right order at the distant point, the eye will accept the presentation as that of a complete picture. We do not even need to present all the areas at the same instant. Assuming that we can present them rapidly enough, such that they are all presented in about 1/16 second, we can present them one at a time and the eye's persistence of vision will retain them all and form a complete picture.

This is important because, as the early workers realised, it is impractical to provide a separate circuit between each elemental area at the transmitter and its opposite number at the receiver. On the other hand, it is relatively easy to interrogate each elemental area on a sequential basis, transmit the information it contains, then move on to the next one and repeat the process. When the last element in the picture has been interrogated, the system starts all over again with the first element and transmits another complete picture. Again assuming that this can be done at 1/16 second — or faster — the eye will not only see a continuous picture, but will be able to observe any movement that occurs.

So much for the broad picture. How do we achieve all this in practice? How do we scan the elemental areas? How do we convert light into electricity and back to light again? How do we keep the receiver scanning in step with the transmitter? What are the practical standards of modern TV systems?

As we have already learned, scanning may be tackled in many ways, including a wide variety of mechanical systems from that of Nipkow to those of Baird and Jenkins. While they have little practical value, their broad principles may assist a detailed discussion of the scanning concept. (Fig 1.)

Let us suppose our subject is a large two-dimensional object, such as a poster or sign. And let us further suppose that, for the moment, we are not interested in transmitting movement.

Facing the poster we set up a bank of photo-electric cells. We start with the poster in near-dark conditions so that little or no light is reflected from it on to the cells. Then we take a concentrated light source, such as a spotlight or sharply focused torch, and shine a small spot of light on the top left corner of the poster. The size of the spot constitutes our elemental area and the smaller we can make it the more detail we will be able to transmit to the distant point.

From the top left corner we move the beam to the right at a steady rate, keeping it parallel to the top edge. As we do so, the light reflected into the photo-cells will vary according to the pattern of the poster. Where it is white the cells will receive the maximum amount of light, where it is black a minimum and, for intermediate tones appropriate amounts of light. These variations will be converted into similar variations of current and transmitted to the distant point.

When the light spot reaches the top right hand corner it is flicked quickly back to the left hand side and, at the same time, downwards by the diameter of the spot. It now traces a second line, parallel to the first, with the top of the new line just touching the bottom of the previous one. Thus, another line of information is trans-

mitted to the distant point.

This line-by-line analysis continues until the last line is traced at the bottom of the poster and the spot reaches the bottom right hand corner. Then it is flicked back to the top left corner again and the whole process repeated.

As a receiver, we might envisage a similar spotlight, arranged to illuminate a screen and scan it in exact unison with the one at the transmitter. The signals from the photo-cells, suitably amplified, would be used to control the light intensity. Provided the whole process was completed within about 1/16 second, the eye would see a complete picture.

As explained in the historical chapters, a number of schemes based on this principle were used by early experimenters. And, as they quickly realised, they suffered from the serious disadvantage that they can be used only where the lighting is under complete control, as in a studio. They cannot be used for outdoor scenes where the natural lighting is high, since the photocells are unable to differentiate between the ambient light and the scanning beam.

The obvious need, therefore, is for some scheme whereby the image can be collected by a lens and projected on to a suitable scanning device located at its focal plane (ie, the position the film would occupy in a conventional camera).

Early experimenters, including Nipkow, either visualised or attempted to make such a camera using mechanical scanning, but with little success. It was not until the development of electronic scanning, and its application to the TV camera, that any degree of success was achieved.

Since electronic scanning is the basis for all modern TV systems, it is worth considering in some detail. Those who are familiar with the oscilloscope will be well on the way to understanding the basic principles, and may with advantage refer to Chapter 18 for a brief refresher.

Electronic scanning, at both transmitter and receiver, uses modified versions of the simple cathode-ray tube used in oscilloscopes. An ordinary cathode ray tube is normally made of glass, is roughly conical in shape, and has a screen of fluorescent material at the larger end. At the small end, and directed towards the screen, is a heated cathode which produces a copious stream of electrons from its hot surface, in exactly the same manner as a valve. (See Chapter 6.)

By means of an electrode assembly known as a gun the electrons are concentrated into a narrow beam and directed towards the screen at quite high velocity. By varying the voltages applied to the gun the beam may be focused to a fine point by the time it reaches the screen. It would normally strike the centre of the screen unless otherwise deflected. (Fig 2.)

When the beam strikes the fluorescent material it causes the latter to emit light, the brightness depending on the rate at which the electrons reach the screen, and the colour on the material from which the screen is made. Almost any colour, or white, can be produced by suitable mixtures of screen materials.

To make use of this electron beam some means must be provided to deflect it to any part of the screen. In the smaller cathode ray tubes, such as used in instruments, the deflection system is built into the tube. Between the gun and screen are two pairs of deflection plates, one nominally horizontal, the other vertical.

If a voltage difference is applied to either pair of plates, the beam will be deflected towards the positive plate. Thus the vertical plates will deflect the beam horizontally, and the horizontal plates will deflect vertically. To avoid confusion, the plates are usually referred to as "horizontally deflecting" and "vertically deflecting." This method of deflection is known as electrostatic, and is most useful in small tubes used in conventional oscilloscopes. It was employed in early TV systems, and still is to a limited extent, but has been almost entirely superseded by **magnetic deflection.**

Magnetic deflection employs deflection coils mounted outside the tube and through which are passed suitable deflection currents. The magnetic fields which they produce deflect the electron beam. A complete deflection coil assembly is commonly called a **deflection yoke.** Magnetic deflection has a number of advantages, particularly where large picture tubes are concerned.

In addition to the various focusing and deflecting electrodes, the tube is fitted with a control grid which functions in almost exactly the same way as its counterpart in a valve. Thus, by applying suitable values of negative voltage (relative to the cathode) the electron stream intensity may be reduced or even cut off completely, thereby varying the light intensity on the screen in a similar manner. This characteristic of the tube is most useful at the receiving end of the system.

By generating suitable voltage or current waveforms, called **sawtooth** waveforms, and applying them to the deflection plates or coils, we can cause the electron beam to trace out a pattern similar to the one we described using a spotlight. The advantage of the electron beam over the light beam is that the electron beam may be deflected virtually instantaneously. The light beam, by comparison, can be deflected only by moving relatively heavy optical elements, thus severely limiting the speed with which we may scan our picture. Alternatively, we would need prohibitively bulky and expensive mechanical systems.

Two sets of deflection signals are needed to produce the pattern we require. One set operates at relatively high frequency and is applied to the horizontal deflection components. This causes the beam to move from left to right across the screen at a steady rate, then return almost instantaneously to the left hand side and repeat the steady sweep. At the same time a lower frequency signal is applied to the vertical deflection components so that the beam is moved down the screen.

By suitably relating the two frequencies the beam is moved downward at a rate which allows the horizontal movement to trace out a series of lines one below the other. When the bottom of the screen is reached, both deflection systems return it quickly to the top left corner and the process is repeated. The pattern which is traced in this manner is called a **raster.**

In the Australian TV system, 25 complete rasters are traced out every second and a complete raster is known as a picture. This figure of 25 is higher than the minimum figure of 16 suggested earlier, and is necessary to minimise flicker. It is also close enough to the normal motion picture rate (24 pictures per second) to enable films to be scanned directly at 25 pictures with negligible difference to the rate of movement or pitch of sound.

But a presentation rate of 25 pictures per second is not sufficient in itself to reduce flicker to an acceptable level. This problem is not peculiar to television; it is also encountered in motion pictures. In the latter case it is overcome by a simple modification to the shutter, whereby each picture is presented twice, thus presenting the eye with a 48Hz flicker rate rather than one of 24.

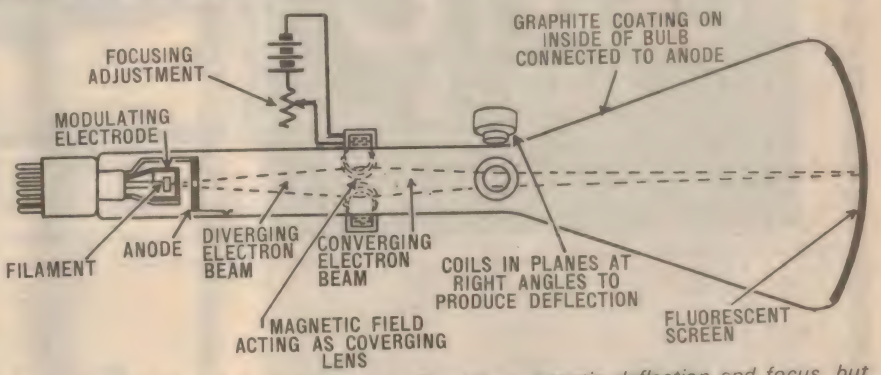


*Fig 2. A cathode ray tube. As shown it is fitted for magnetic deflection and focus, but electrostatic focusing is often employed. In practice the deflection coils are larger and combined into a single unit called a yoke. A receiver picture tube has a much larger screen and is much shorter relatively.*

In TV systems the problem is overcome by a technique called **interlaced scanning,** which is a variation of the simple scanning process already discussed. In simple scanning we assumed that the lines would be scanned in logical sequence, 1, 2, 3, 4, etc, starting from the top of the picture. In the interlaced system we scan all the odd numbered lines first, ie, 1, 3, 5, 7, etc, then return to the top of the picture and scan the even lines, 2, 4, 6, 8, etc. Either one of these scans is called a field.

Thus we fill the screen with half the total light 50 times a second, rather than the total light 25 times a second. As far as the eye is concerned, it reacts almost exactly as if we had presented 50 complete pictures per second, rather than only 50 fields. At the same time we avoid the serious bandwidth complications which could result from trying to present 50 complete pictures per second. (We will discuss "bandwidth" in detail a little later.)

The interlace function is not as difficult to provide as might be imagined, and is mainly a matter of selecting suitable

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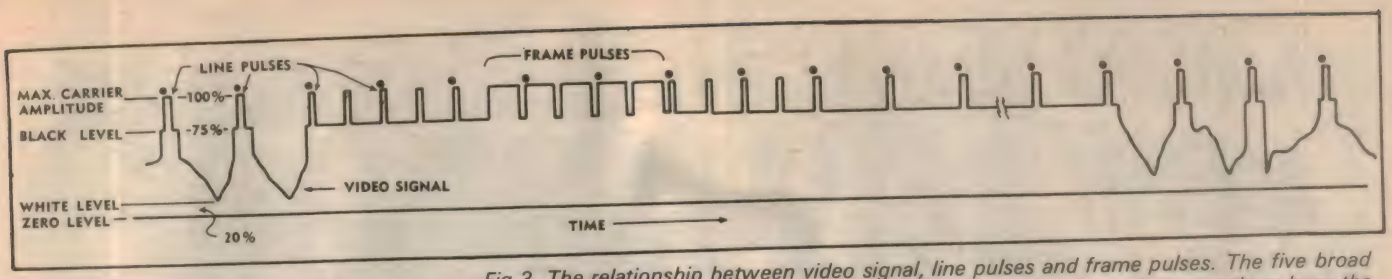


*Fig 3. The relationship between video signal, line pulses and frame pulses. The five broad frame pulses are integrated into one large pulse, while the spaces between them keep the line oscillator in step.*

transmission standards. One of these is the vertical scanning rate, which must be double the rate of complete pictures to be presented per second. Thus, to present 25 complete pictures per second we scan the picture vertically 50 times per second. The other requirement is that the number of lines per picture must always be an odd number, regardless of the actual standard selected (eg, 405, 441, 525, 625, 819).

The odd number of lines means that each field will involve an odd half line ie, for the 625 line system each field will consist of 312½ lines. The time needed to scan half a line is also the time needed for the vertical scan to move downward by half the distance between the previously scanned lines, say the first and third. Thus the second field interlaces the first field automatically.

So far all our references to scanning techniques have simply assumed that we can provide some means of keeping the scanning system at the receiver in step with the one at the transmitter, without offering any explanation. This process is called **synchronisation** or more commonly, **sync.**

Synchronisation is achieved in practice by transmitting a regular pattern of pulses, called **sync pulses**, along with the picture information. Success of the system is based on the assumption that the receiver deflection circuits can quite easily be adjusted to run at approximately the frequency required and that this is all that is required if the pulses from the transmitter can be used to provide the final frequency correction and to adjust the phase. (Fig 3.)

There are two sets of sync pulses, one for each of the deflection oscillators. To control the horizontal oscillator, a single narrow pulse is transmitted at the end of every line. This "instructs" the scanning oscillator to return the beam to the left hand side of the raster (**retrace**) and commence tracing a new line. During the retrace and scanning period the deflection oscillator is "running free", and subject only to its own frequency determining components.

To control the vertical oscillator a series of pulses are transmitted at the end of each field. They are broader than the line pulses and grouped close together, which enables the system to distinguish them from the line pulses. It does this by **integrating** (adding together) the pulses to make one large pulse, which then serves to "instruct" the vertical oscillator to retrace to the top of the raster and commence a new downward scan. As with the horizontal oscillator, the vertical oscillator "runs free" after being triggered by the sync pulse.

The times during which the pulses appear at the end of each line and each field are called **blanking periods**, and no picture, or **video**, information is transmitted during this time. The blanking periods appear as a black border around the picture. Thus by reason of their position, in time, the sync pulses do not interfere with the picture information.

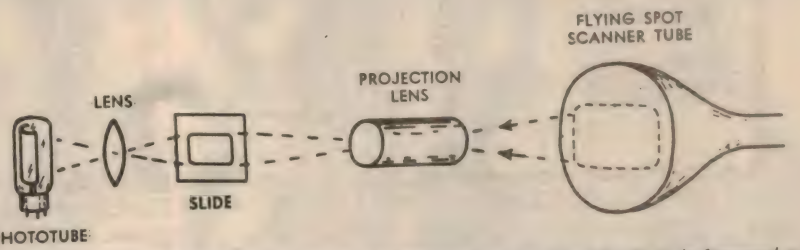


*Fig 4. A simple form of electronic scanning. A raster traced on the tube face is focused on to a transparency and then on to a photo-electric cell. Output from the cell becomes the video information.*

However, the reverse is not automatically true, and it is conceivable that video information could be "seen" by the synchronising circuits and mistaken for sync pulses. This is overcome by presenting the video and sync pulses at different levels. In the Australian system, and most others, a peak white signal is represented by about 20pc modulation, peak black by about 75pc modulation, while the sync pulses occupy the "blacker-than-black" region between 75pc and 100pc modulation. In the receiver, it is relatively easy to provide a circuit which will not respond to any signals lower than 75pc but responds quite readily to values above this. Thus the sync pulses are effectively separated from the video signal. This circuit is called a **sync separator.**

At this point, with our scanning and synchronising systems all nicely worked out, the reader may fairly ask how we use an electron beam to scan the image at the transmitter. One simple way is to use what is called a flying spot scanner, which has valuable, though limited, practical applications. In this arrangement the electron beam traces the raster on a fluorescent screen, exactly as in conventional cathode ray tubes. The screen is located behind a transparency of the image to be transmitted, and a photo-electric cell is placed in front of it. Thus the cell registers the amount of light passing through the transparency as each part is scanned, and the cell output becomes the video signal. (See Fig 4 above.)

Naturally, this arrangement is limited to material which can be presented in transparency form and is of no value for "live" images collected by a lens. To scan these we need a very much more complex tube. A number of these have been developed, such as the **iconoscope**, the **image orthicon**, the **vidicon**, and the **plumbicon**. It would be impossible to deal with all these basic types, and the variations on them, in a short article like this. However, a brief description of two of them may prove helpful.

A basic item in most picture tubes is an electrode which is referred to variously as a **photo-cathode**, a **mosaic screen**, a **signal plate**, or a **target**. It commonly takes the form of a mica sheet ranging in size up to 100mm square and about 25 microns thick. One side is coated with a continuous film of metallic silver. On the other side are deposited countless particles of metallic silver which are oxidised and made light sensitive by treatment with caesium. The particles are quite separate and insulated from each other. (Fig 5.)

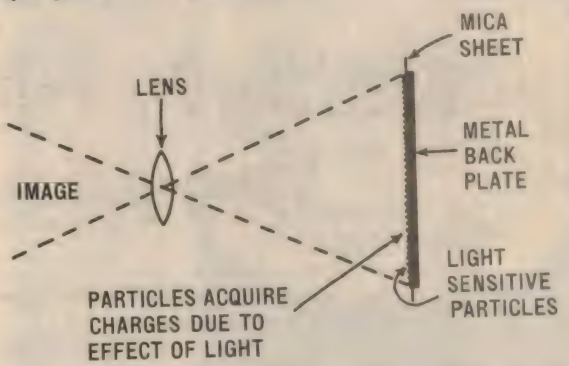


*Fig 5. The heart of all camera tubes is some form of photo-sensitive mosaic. Each photo-sensitive element is small by comparison with an elemental area in typical systems.*

There is obviously a certain capacitance between each particle and the back plate so that the mosaic, in effect, can be regarded as an assembly of countless tiny capacitors, with one common plate, and every other plate photo-sensitive. Under the influence of light, a potential difference tends to build up between each of the silver particles and the back plate. If an image is projected on to the photo-cathode by ordinary optical means, the individual tiny capacitors tend to

acquire a charge proportional to the light and shade of the picture.

The function of the tube is to scan these tiny charges, converting them into picture signals.

As related in our historical chapters, the earliest form of picture tube was known in America as the "Iconoscope" and, in England as the "Emitron." (Fig 6.)

The photo-cathode is mounted in the main body of the tube. The scene to be televised is focused through an ordinary lens system on to the light sensitive surface. Under the influence of the light and shade, the tiny silver particles emit electrons and begin to acquire a positive charge. The charge continues to build up, according to the incident light, until it is ultimately released by the electron beam.

It is important to note that light falls on the photo-cathode all the time, and that the charging process by the minute capacitors is likewise continuous.

When the charge is ultimately released, it is quite substantial as a result, and this makes an important contribution to the sensitivity of the Iconoscope or Emitron.

Scanning is achieved by means of an electron beam generated in the neck of the tube. This beam is made to scan the surface of the mosaic, line by line in the manner already described. The precise effect of the electron beam on each tiny capacitor is rather complex, and a detailed examination is hardly warranted at this juncture. Sufficient to say that electrons from the beam replace those which have been emitted as a result of the photo-electric effect and discharge the tiny capacitors as it passes across them.

The resulting change in potential is naturally communicated to the common back plate and a voltage is generated across the load resistor "R." This is subsequently amplified, becoming the picture signal which modulates the transmitter. Primary and secondary electrons released from the photo-cathode are collected by a ring or metallic coating inside the body of the tube.

The most popular modern tube is the Image Orthicon. It has always been highly regarded, and the very latest versions are capable of superb results.

Physically the Image Orthicon looks rather like a projection display tube, being about 38cm long and about 11cm in diameter at the head. It employs a single photo-cathode like the Iconoscope or Emitron, but transparent to light. The basic principles are illustrated in Fig 7.

Electrically, the Image Orthicon is divided into three distinct sections, an image compartment, a scanning section and an electron multiplier.

Light rays from the image are focused on to the transparent photosensitive mosaic. Electrons are emitted from the inner surface in proportion to the light and shade of the image. These primary electrons are accelerated away from the photocathode by an anode structure, and an extremely fine mesh-like grid, which carries a positive potential. The electrons pass through it at relatively high velocity and strike a second mosaic having high secondary emissive qualities.

The base for this second mosaic is actually a film of glass only 2.5 microns thick. It is so thin that it is transparent to electrons and the charges which accumulate on the front can influence or be influenced by electrons from an electron gun at the rear. When electrons strike the front of the glass screen they create on it an electron image, equivalent in density to the visual image on the photocathode. The impact of these primary electrons causes secondary emission, and individual particles of the mosaic acquire varying positive charges as a result.

The rear of the glass target is scanned by a low velocity electron beam, the electrons being slowed down just before they reach the rear surface. The beam gives up just enough electrons to neutralise the positive charges at each point of the mosaic, and the remainder of the electrons immediately reverse direction and return to a structure surrounding the gun. This structure is actually a form of electron multiplier which greatly amplifies the variations in electron current from the target.

The Image Orthicon combines the outstanding features of all previous tubes and the result is a tube of high sensitivity and small size. The Image Orthicon also puts the gun, the mosaic and the image all on the same axis and eliminates the need for the obliquely mounted neck, as in the Iconoscope and Emitron. It avoids problems with trapezium distortion, clears the lens mount and makes possible the use of a lens turret.

Another type of tube in common use is the Vidicon. This is normally a small tube, about 25mm diameter, and is used extensively where the physically small camera and lens with which it can be used are of greater importance than some other factors. It also has the advantage of low first cost and relatively long life. On the debit side it suffers from limited definition and sensitivity and a tendency under low light conditions to retain an image for longer than is desirable, giving rise to smear on rapidly moving objects.

In spite of these disadvantages it has found use in industrial and educational applications as well as in TV stations, where it is useful for presenting captions, films, etc. A more recent version of this tube, called the Plumbicon, has eliminated a lot of the Vidicon problems, and is currently finding a wide application, particularly in colour cameras.

The essential basic elements of a vidicon camera tube are shown in Fig 8. A standard optical lens system focuses an image of the scene to be televised on to a "target" electrode which consists of a thin layer of photoconductive material (usually antimony trisulphide or a compound of silver, bismuth and caesium). A permanent electrical connection is made to the lens side of the target by means of a thin transparent "signal plate" electrode of tin oxide. The rear side of the target is scanned by a low-velocity electron beam.

The target material is essentially a dielectric whose leakage resistance varies from a very high value to a relatively low value with increasing incident illumination. Typical values for transverse or front-to-rear resistance of a small elemental area are 20M for zero illumination and 2M with maximum nominal illumination. The lens side of the target and the signal plate are connected via a resistor (usually around 50K) to a supply providing some 20 to 45V positive with respect to the electron gun cathode. The resistor becomes the "video load," across which appears the video output signal.

Because the target layer is very thin, leakage in the plane of the layer surfaces is negligible compared with transverse leakage. As a result the target effectively consists of an array of many thousands of parallel C-R elements, the "front" connections of each being commoned together by the signal plate. The "rear" connections

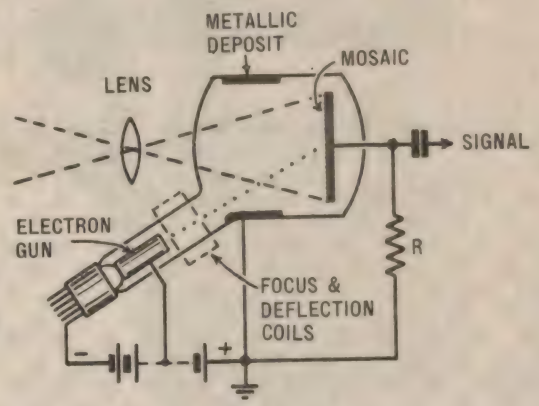


*Fig 6. One of the first practical camera tubes, the Iconoscope. Note the angle of the electron gun which presented both optical and mechanical problems.*

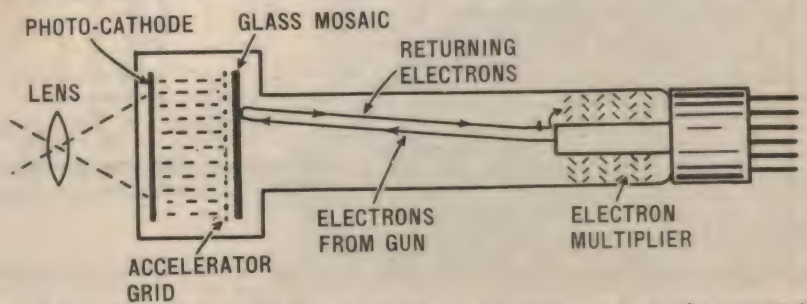


*Fig 7. A simplified drawing of the image orthicon, one of the most popular camera tubes currently in use. Note the "in line" construction, which simplifies mechanical and optical design.*

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are scanned by the electron beam.

As the electron beam is scanned across the rear of the target layer, it in effect connects the "rear" end of the target elements to the potential of the electron gun cathode. This it does by supplying electrons to the elemental "capacitors" so that they become charged to the target supply voltage.

In the 20ms between successive scans the charge on an element tends to leak away through its transverse leakage "resistor." The extent to which this occurs will depend upon the incident light ie, the picture information at that particular point on the target image. If there is little or no incident light, the charge will hardly leak away at all, whereas if the element corresponds to a bright spot on the image the charge will leak away appreciably before it is again scanned by the electron beam.

When each element is re-scanned, the number of electrons which will be supplied to it by the electron beam in restoring its charge will depend upon the amount of leakage that has occurred in the inter-scan period — and hence upon the average incident light falling on the element during that period. Thus current will flow through the electron beam, target, video load and target supply, whose instantaneous value will be proportional to the incident light falling on each of the elements being scanned; and across the video load will appear a corresponding voltage fluctuation which becomes the video output signal. The latter will be negative-going — ie, bright picture areas will produce negative excursions.

There is another, quite different, approach to TV camera design currently being developed and, while it is unlikely to replace existing devices for some time yet, it is well worth considering. One interesting aspect of it is that we appear to be coming full circle once more; back to some of the very first suggestions for a TV system.

It may be remembered from our historical chapter that around 1875 Carey proposed a screen or mosaic of photocells onto which would be projected, by means of a lens, an image of the scene to be transmitted. Each cell was to be coupled to a corresponding lamp at the receiving end by a separate wire.

In later years other workers, notably Jenkins, actually tried this idea with limited success. However, Jenkins used only a single circuit between the camera and the display screen, interrogating each cell sequentially with a mechanical commutator which ran in step with a similar commutator connected to the lamps of the display screen.

A very important aspect of Jenkins' scheme was that each photocell was associated with a small capacitor and it was, in fact, the energy stored in this capacitor which was fed into the system as the commutator arm interrogated each elemental area. The importance of the capacitor was that it allowed the photocell to work — by charging the capacitor — during the whole of the scanning cycle; not just for the moment when the commutator interrogated it. This resulted in a very marked increase in sensitivity.

Current development is towards a solid state version of this scheme, and some units are already finding limited application in specialised fields. Like Jenkins' device, they consist of a mosaic of photocells, each with its own capacitor and connections for the external scanning circuitry.

But there the resemblance ends. Whereas Jenkins' screen was several square feet in area, modern integrated circuit technology can fit a similar number of cells, and their associated capacitors, into a few square millimetres. And in place of the clumsy mechanical commutator we can now use the latest solid state electronic switching circuits.

In the units developed so far, definition has been strictly limited. A typical unit by RCA (ref "Electronics Australia", April 1973, p16) employed only 1408 elemental areas; 32 lines of 44 elements each. This is very similar to the standards employed by Baird, Jenkins, and others but the significant point is that this number of cells is now accommodated in an area roughly equal to that of an 8mm home movie frame.

And, whereas the standards of the early workers represented the limit of the technology as it was then, the present effort is only the beginning. While, initially, there may be difficulty in fabricating units with a substantially larger number of elements, at least economically, there seems little doubt that these problems can be overcome.

The advantages of such an arrangement would be many. A much more robust construction, long life, minimum sensitivity to stray magnetic fields, virtual elimination of non-linear scanning problems, and a significant saving in space and weight are a few that are immediately obvious.

Now that we have learned something of the practical aspects of scanning and camera tubes we are in a better position to consider typical standards as used in modern TV systems. Earlier, we introduced the "elemental area" concept. It is important to retain this concept, even though the subsequent discussion may have placed more emphasis on "lines" than "areas."

The number of lines in a (horizontally scanned) picture determines the vertical resolution only. Horizontal definition is a function of how many transitions from black to white can be accommodated in a single line. As a rough approximation we may consider that, for a square picture, we need as many elemental areas per line as there are lines in the whole picture.

As an example, consider Australia's 625 line system. Since the picture is wider than it is high by the ratio 4:3 we should provide 625 x 4:3, or about 830, elemental areas in each line. Multiplying this by 625 we get 520,000 elemental areas per picture.

What governs the number of elemental areas which we can provide in one line? In simple terms it is a function of how rapidly we are able to switch the picture tube electron beam on or off representing an abrupt transition from black to white. The electron beam itself will respond at almost any speed we like to nominate, the real limitation being the signal we apply to it. This in turn, is limited by the high frequency response, or **bandwidth**, of the entire system.

In the example just cited we have 520,000 elemental areas in one picture, which we must transmit completely 25 times a second. Thus we have to transmit 520,000 x 25, or about 13 million, elemental areas each second. If we consider the extreme case where adjacent elemental areas are alternately black and white it can be shown that we can transmit two elemental areas per cycle of video signal. So, to transmit 13 million elemental areas per second we would need to transmit 6.5 million cycles per second (6.5 million Hz or 6.5MHz).

Transmitting a signal of this kind presents a number of problems. First we have to provide a carrier frequency high enough to accommodate such an order of modulation, which must be at least several times the modulating frequency. This fact, plus the space which such a signal must occupy, automatically dictates nothing less than the VHF bands, from about 50MHz to 300MHz. Even here spectrum space is precious, and every effort is made to reduce the needs of the TV transmitter as much as possible.

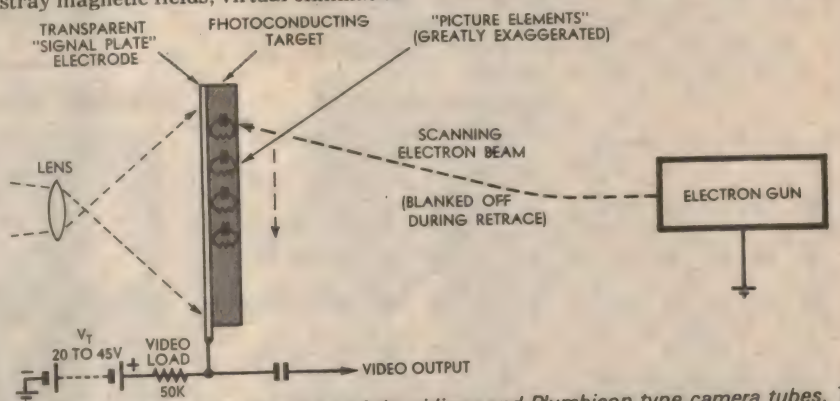


*Fig 8. Illustrating the basic principles of the vidicon and Plumbicon type camera tubes. The Plumbicon version is free of the low light level smear problems, mainly due to the use of lead oxide as the target material. They are used extensively in colour cameras.*

One trick is to employ a form of single sideband transmission (**vestigial sideband**), where as much as possible of one sideband is suppressed. Another is to accept some compromise between the number of elemental areas we would like to transmit and the minimum number which will noticeably degrade the picture. In the Australian system we provide a total bandwidth of 7MHz for each TV channel, which has also to accommodate the sound channel.

Within this we provide a video bandwidth of about 5MHz; a little less than the theoretical ideal. However, this order of performance is seldom matched by the receiver, which would be regarded as quite good if its bandwidth extended to 4MHz. Nevertheless, the end result from a good TV set can be very satisfying if the original material is good.

This covers most aspects of TV transmission and is all we can discuss in this chapter. In the next chapter we will describe the other end of the link, the receiver.

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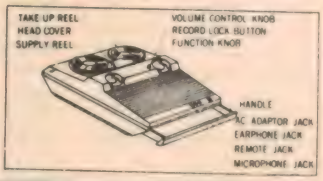


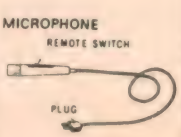


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# Equip your car with a burglar alarm

## (Part 2)

Elementary Electronics

by Ross Tester

Continuing our burglar alarm description. Besides the additions promised last month, we have added a couple more ideas. We have built the unit on a printed wiring board and mounted it inside a metal box for greater reliability and ease of construction.

In our series on multivibrators late last year, we described them as "very much an integral building block in electronics." We are sure most readers will agree — this month we are using another!

Last month, we promised an addition to the automotive burglar alarm which was described in that issue; a circuit which would turn the alarm into a "beep beep beep" device instead of a single note.

A multivibrator provides one of the simplest ways to accomplish this. But more about that in a moment. Since we described the alarm, we have had time to think about improvements other than the beeper. One of the first was to arrange the circuitry on a printed wiring board.

Note that this does not mean the alarm must be built on the board. If you would rather not spend money on a printed board (they will be priced around two dollars) by all means leave it in its orginal form on a tagstrip.

In our minds, however, a printed board has several major advantages. First, it is much easier to construct a project on the board. Mistakes are nearly impossible providing the diagrams are followed exactly. A much neater and more compact circuit is also one of the advantages. We have been able to accommodate the original circuit, plus the additions mentioned, on a board measuring only 11 x 5.5cm — the original circuit alone on a tagstrip measured 16 x 6cm.

As a bonus, the size of the printed board allows it to fit into one of the economical aluminium "mini boxes." The size we chose was 5in x 2¼in x 2¼in (approx. 12.7cm x 5.7cm x 5.7cm) and is known as a type AMB9.

On the other hand, use of a printed board calls for a small change in components. The 2200uF electrolytic capacitor has been changed to 2 only 1000uF electrolytic types, connected in parallel. The change is due simply to the difficulty of obtaining the 2200uF unit in a single ended type, which is desirable in order to save space.

It may be possible to fit a double ended type, making it into a single ended type by simply bending one pigtail back along the body and strapping in place with a turn of plastic insulation tape. However, make sure that the box you have chosen will accommodate the height of the capacitor.

Unfortunately, a small "bug" crept into the alarm circuit as we published it last month. Due to lack of time, we overlooked it before our deadline — by which time it was too late to change.

In our first prototype of the alarm, we provided an exit time delay of 45 seconds, an entry time delay of five seconds, and an "alarm on" time of thirty seconds.

This worked very well — but we had an idea some readers would like an "alarm on" time of at least a couple of minutes. So we modified the original circuit at that point to give this order of delay. (As published, "alarm on" times of over five minutes are possible).

In doing this, however, we overlooked one important point: the "alarm on" storage capacitor (2200uF) is fully charged each time the door is opened, and will take its normal time to discharge. And, as it is still partially charged after the exit time delay has timed out, it is able to bring up the alarm.

And this is exactly what happens. The alarm sounds after the car is left, for as long as the 2200uF capacitor continues to discharge — and this can be as long as two or three minutes. Fairly obviously, this is completely unacceptable, even though, after the initial sounding, the alarm re-sets itself and will behave as it should.

Naturally, we have taken steps to overcome this situation — and to incorporate these changes on the printed board. We solved the problem quite simply.

All we had to do was to stop the "alarm on" capacitor(s) charging until the exit time had expired. To do this, we had to disconnect the top of the capacitor(s) from the positive rail until the exit time delay had completed its cycle. By this time the door would be well and truly closed, removing the charging path in the negative side of the capacitor circuit.

The most obvious thing was to connect the positive side of the capacitors to the emitter of the exit delay transistor (TR1). This point assumes the positive rail voltage (or close to it) only after the delay time has expired.

We tried this idea and it worked quite satisfactorily. The only change in behaviour is a reduction in exit time. This is now about 10 seconds; still ample for a person to close the door after setting the alarm switch.

The circuit has been modified accordingly, and the printed board designed to accommodate the modification. We

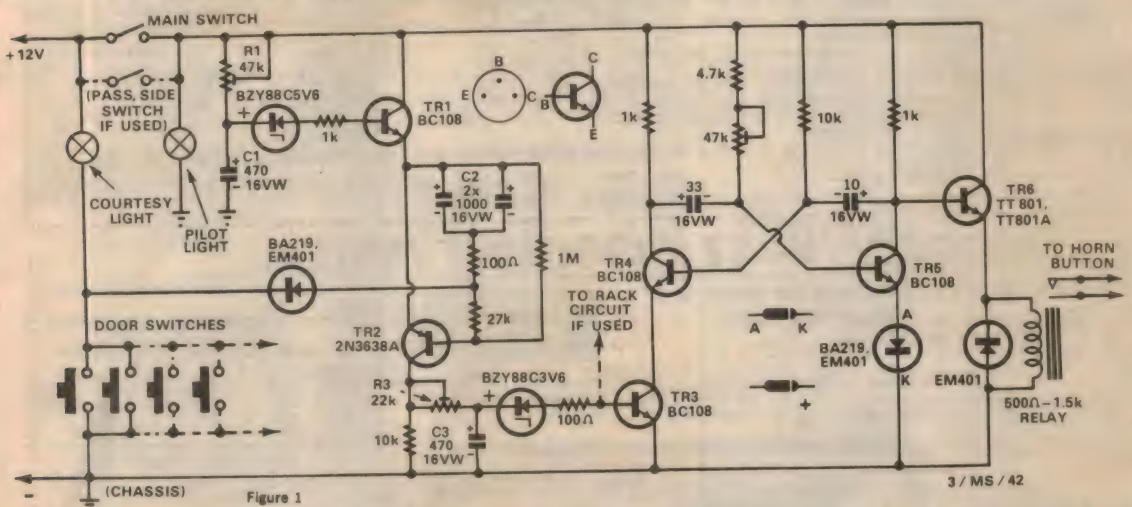


Figure 1

*Our final burglar alarm design. The major change is the addition of a "beep beep" function for the horn, provided by TR4 and TR5 in the multivibrator configuration. The 1M resistor in TR2 base circuit gives maximum "alarm on" time. Lower values will shorten this.*

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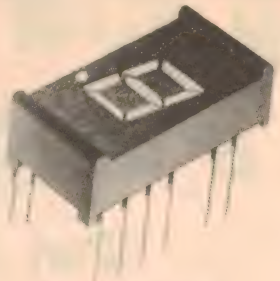

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apologise to any readers who have been tearing their hair out trying to find their error!

Apart from these changes the new circuit is identical up to TR3, the BC108 used in the Darlington pair driving the relay. No longer is this part of a Darlington pair, but a switch used to turn the multivibrator on and off.

This is a standard astable multivibrator, deliberately unbalanced (to obtain unequal times) by the use of different values of capacitors in each half.

Speed control is by a preset pot in one of the bias legs. This enables the speed to be set anywhere from a fast "bip bip . . ." to a long "beeep . . . beeeep . . ."

Many other speeds are possible; these may be obtained by altering the values of bias resistor(s) and pot. Control of the duty cycle (on time to off time) is possible by changing the capacitors.

Following the multivibrator, we have a single TT801A transistor used as a relay driver (TR6). There is no need for a Darlington pair in this circuit, as plenty of drive is available at the TR6 base. This drive is controlled by the multivibrator.

When TR5 is cut off, TR6 receives ample forward bias via R4, TR5's collector load. When TR5 conducts, the collector voltage falls to near zero and TR6 receives no forward bias. As the multivibrator is changing backwards and forwards while ever its switch (TR3) is turned on, the relay opens and closes in sympathy.

(For a full explanation of how a multivibrator works, refer to our series on multivibrators, which commenced in the October, 1972 issue).

So much for the operation of the basic alarm and multivibrator circuit. But what of the other addition we were talking about?

This is, quite frankly, an afterthought. After the board pattern was completed, and the prototype in operation, we started thinking about other aspects of automotive security. Apart from hubcaps, which are very difficult to protect, the most vulnerable thing on a car is a roof rack or board rack.

Many people who own sets of racks leave them off the car except when they are actually needed — simply because they are afraid of them being "knocked off." So we decided to see what we could do about protecting roof racks.

We came up with the circuit in Fig. 4 This requires only one additional transistor and two resistors — and can be mounted on a short piece of tagstrip inside the case, with only one wire emerging.

A minor modification to your roof-rack set up may be required, but we will explain this in a moment. If more than one rack is involved (as in the case of board racks) both can be protected by connecting them together as shown in Fig 4 (b).

Roof racks are fitted in one of two ways. On older cars, where paintwork protection is not all that important, they are clamped directly into the gutter. In newer cars, to protect the paintwork, a piece of plastic material is placed between the rack and gutter.

Our protective circuit relies on a connection between the rack and the chassis of the car. Where the rack can be bolted directly to the chrome gutter this comes automatically, but where plastic protectors are used some other method will have to be found. Just how, we will leave up to the reader.

The rack is then connected via a length of wire to the base of a BC108 or similar transistor. The BC108, in turn, is connected to the supply, via suitable load and bias resistors, and to the base of TR3 — the multivibrator switch (see Fig 1).

Now the reason for the connection between the rack and car chassis should be obvious. While ever the base of the transistor is held at chassis potential via this link, the transistor remains off. But as soon as the link is broken, the transistor turns on hard and the multivibrator switch is also turned on.

The roof rack alarm deliberately bypasses the delay circuits to make the horn start immediately. The reason for this is simple — you know that the rack cannot be removed with the burglar alarm on, and you do not have to gain access to turn anything off. So there is no point in giving the thief a few more seconds in which to make good his escape with your rack.

We are aware that the transistor will stay on — and so will the horn — but we could not warrant an extra re-set circuit for this "add-on" section. Once the normal delay circuits are bypassed (as we have done) they cannot be used to re-set after a certain period.

Construction of the alarm should not prove difficult, even for a beginner. Some readers may be wary of using printed boards — if this is the first time you have tried them, the following tips might prove an advantage:

The most likely source of trouble is your

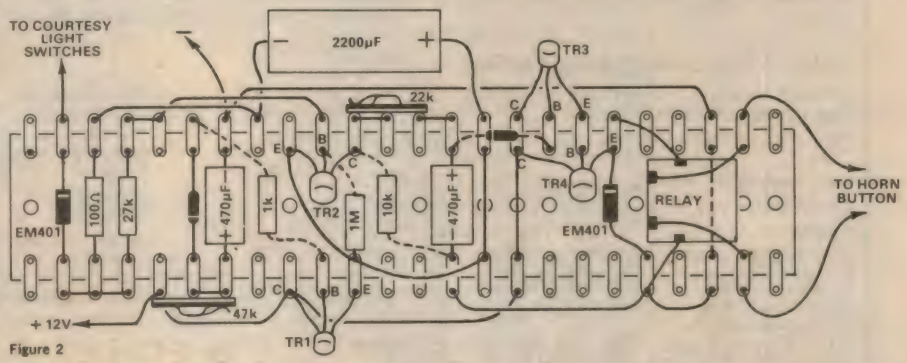

Figure 2

*The wiring diagram from last month's article, modified to overcome the problem discussed in the text. If the multivibrator circuit is to be added to this arrangement, it could be most conveniently mounted on a second length of terminal strip.*

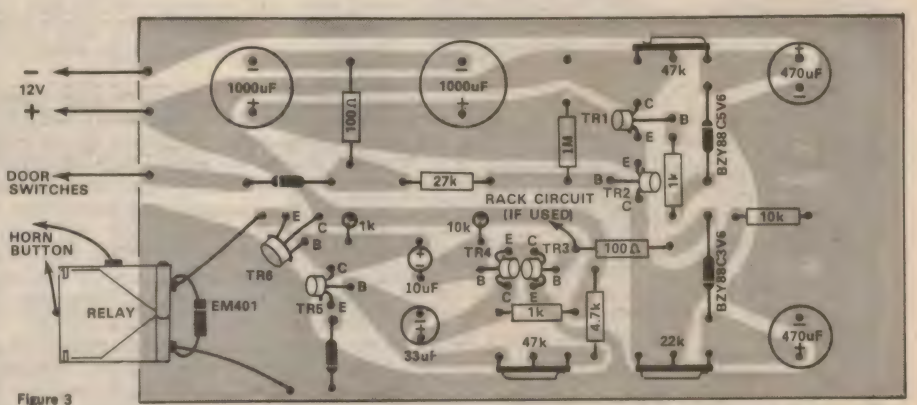

Figure 3

*The printed wiring board, from the component side. It is reproduced correct size. Note that the protective diode for the relay is not shown on the board, being mounted directly on the relay. However, its position is not critical.*

soldering iron. Unless you are very experienced you should not, in any circumstances, use a quick heating type soldering iron on printed boards. You run the risk of damage to the copper tracks. Such irons, while very handy for many jobs, have a tendency to overheat and cause the glue which bonds the copper to the base to give way. Once the track has lifted, it is difficult to repair.

The best type of iron for printed board work is one of the low voltage, low wattage types with a fairly small tip. The author uses a 4V, 10W type with a ⅛in tip. For this type of work, this is close to ideal.

Because printed boards are usually sold with at least a protective coating of flux, they are usually easier to solder to than tagstrips or matrix pins. Some boards are actually coated with a thin layer of solder — a technique which virtually eliminates dry joints.

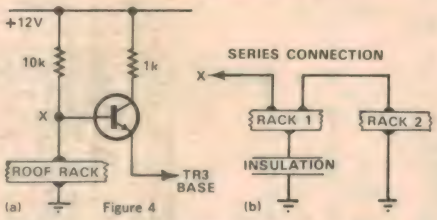

Figure 4

*When contact between rack and car is broken, this circuit sounds the horn. It can be placed on a tagstrip within the alarm case.*

Even though the board may be coated with flux, it is necessary to use flux cored solder — the type normally used for electronics work. Ordinary stick solder is unsuitable.

Remember to observe the correct polarity for all components (except, of course, resistors). Failure to do this will, at best, prevent the alarm from working. At worst, it could damage a lot of components.

Place all resistors on the board first, and bend their leads outwards at about 45 degrees to hold them in place. Then solder them in position by placing the end of the solder on both the lead and the copper, and bringing the iron onto both at the one time. You will probably notice an accumulation of solder on the iron after a while — this should be removed, as it will have had the flux burned out of it. A moist kitchen sponge is ideal for this purpose — simply wipe the old solder away periodically.

After the resistors, place the zener diodes, ordinary diodes and transistors on the board, and solder them in the same way. Lastly, mount the vertical electrolytics and pots. The reason the larger components are left until last is simply that they get in the way if put in first.

The old problem of overheating a semiconductor component by holding the iron on it too long is now largely a thing of the past. Modern devices are nowhere near as sensitive to heat, and can usually be soldered without use of protective heat shunts. Even so, if you do not have much experience soldering, it may still be a good idea to use a heat shunt on each of the semiconductors when soldering into place. Use something like an alligator clip, pair of surgical forceps or ordinary needle nose (pointed) pliers.

After completion of the soldering job, inspect the copper side of the board to make sure that no solder has bridged any of the tracks together. If so, a quick touch with the iron and these should be removed.

No mounting holes have been marked on the board. This will be left up to the individual — there is plenty of room for mounting holes to be drilled in each corner.

While there is space left in the corner of the board for the relay, we feel it would be best if the relay was not mounted on the board, but on the side of the case, above the space on the board. Not only will this allow more rigid mounting of the relay, but will leave space for a mounting screw underneath.

The relay should be mounted vertically (ie, with the armature in a vertical position) for another important reason. When driving, the car is, from time to time, going to hit some bumps and potholes. If the relay is a type which is not heavily sprung (ours falls into this category) the situation could arise where each bump jars the relay closed, thus sounding the horn. This could be quite embarrasing.

Depending on the way the relay is mounted, heavy braking can be allowed for too. Remembering that the armature is going to want to go in the same direction the car is moving when brakes are applied, choose the mounting to make the normally off position of the armature farthest forward. This way the horn should not sound unless it is supposed to.

The board can be mounted on four 1in screws, with nuts either side of the board to hold it level and in place. As long as the height of the capacitors will allow it, the board should be mounted level with the flange. This allows any screws in the outer case to pass underneath the board without fouling it. It also allows the holes for potentiometer adjustment to clear the flange.

To make for easy connection to the car electrical system, we terminated each of the six wires from the alarm (positive, negative, door switch connection, roof rack connection, and two relay connections) in a piece of mains terminal block screwed to the outside of the case. This saves fiddling around with a lot of connections when installing the alarm — a screwdriver and the job is done!

Remember to mount the alarm box out of sight — and to keep any new wires introduced into the system hidden as well — it is usually easy to lift the floor mats and place wires underneath.

When the alarm is completed, check it by connecting it to a 12V supply, with a light globe and switch simulating the courtesy light circuit (as shown as part of the main circuit diagram in Fig 1). Place an ohm-meter across the relay leads, and connect the rack protection circuit (if fitted) to the negative supply. By adjusting the various pots (it might be an idea to mark the access holes) you should be able to obtain the proper delays for proper operation.

As a final check before installation, close the simulated courtesy light switch, then close the main switch. Release the courtesy light switch after, say, five to ten seconds. The ohm-meter should read open circuit continuously. Then close the courtesy light switch again for a couple of seconds. You should find that after the delay set by you the meter should alternate between open and short circuit. Adjustment of the multivibrator pot will give you the speed required.

# Elementary Electronics Ideas Worth Trying

## Small Parts Drawers

We all have trouble finding a place for small components, particularly those, like resistors and capacitors, which are needed in such a wide range of value. What is needed is a storage system that will allow them to be conveniently located, but which will also stand up to a reasonable amount of use.

My solution to the problem was to use matchboxes glued together. The value of the component is written on the front so that it can be located at a glance. When a component is required, the drawer portion is pushed from the back.

I find a unit of four drawers wide by eight drawers high most convenient, and it is sturdy enough to carry in my toolbox.

(Mr C. W. Johnson, 51 Avon St, Leichhardt, 4305.)

(Note: More than one reader submitted this idea. We have published the one we felt was best presented.)

## Desoldering Braid

When removing components from printed wiring boards, some means of removing the solder from around the joints is needed. One method is to use desoldering braid, available commercially. It can also be made quite simply and cheaply.

Ordinary copper braid, about ⅛in wide, is readily available from electronic supply houses. Cut this into strips about 6in long and soak them in a resin-methylated spirit solution for several minutes, then take them out and allow them to dry. In use, the resin acts as a flux to allow the solder to adhere to the braid.

(Mr K. Mahlo, Box 43, PO Lyndoch, 5351.)

## Original Ideas Wanted

Many of the contributions submitted to this section have, quite obviously, been lifted straight from overseas magazines, to which we also subscribe. For obvious reasons, these are not eligible for publication.

However, where a reader has built a project from such a source and is thus able to comment on its performance, or suggest worthwhile modifications, AND acknowledge the source, we may find the article acceptable, depending on its merits.

## Transistor Repair

It is annoying when a transistor lead breaks off flush with the bottom of the transistor, especially to people like myself, whose finance is limited. Since one has nothing to lose, the following idea is worth trying.

Select a piece of bare wire, several inches long and of similar gauge to the transistor leads. The extra length is needed to help make the repair, and can be trimmed off later. To hold the wire use a pair of pliers with a rubber band around the handles. (An idea from "Ideas Worth Trying.")

Put a blob of quick drying glue on the bottom of the transistor, over the broken lead, and also on the end of the new lead. A toothpick is handy for applying the glue.

Leave the glue to become tacky and, while waiting, connect the remaining transistor leads, and the new lead, to the appropriate terminals of a transistor tester. Use flexible leads with alligator clips on each end for this. These are useful devices for other jobs also. (It may also be possible to use a multimeter. See "Testing Transistors with a Multimeter," November 1968. Ed.)

When the glue is tacky, rest the pliers holding the new lead on the table, push the new lead into the glue on the transistor, and move it around until the meter shows that the new lead is touching the end of the broken lead. Hold everything carefully until the glue dries.

To make a stronger job apply Araldite or some similar material over the glue. Treat the repaired transistor very carefully. Patience is needed, but I have successfully repaired two transistors this way.

(While the long term reliability of such a repair may be doubtful, it could be useful at an experimental level, as the writer suggests. Ed.)

(Mr S. Pratten, Koolewong, Borenore, 2800.)

# CLASSICAL RECORDINGS

Reviewed by Paul Frolich

## *Margaret Sutherland — The Young Kabbarli*

**SUTHERLAND — THE YOUNG KABBARLI (complete opera). Genty Stevens, John McKenzie, Dean Patterson, Carol Kohler; David Gumpilil; Didjeridu and 10 instrumental soloists, conducted by Patrick Thomas. H.M.V. quadraphonic stereo Q40ASD 7569 (Recorded at Flinders University, Adelaide).**

This beautifully-produced record, with a sleeve graced by Charles Blackman drawings, is truly a landmark in local record manufacture. To begin with, it is the first complete operatic recording ever made here; it is the first complete recording, anywhere, of an Australian opera; and it is the first locally-made quadraphonic disc. As for the last, few listeners, as yet, possess such equipment; but don't let that deter you: the record sounds excellent if played on standard stereo equipment and is, if anything, at least marginally superior to the general run of stereo pressings.

"The Young Kabbarli", a one-act opera based on an episode in the life of Daisy Bates, was composed by veteran Australian composer Margaret Sutherland in 1964. It had its second production in November 1972, as part of the 75th Birthday Celebrations in honour of the composer and the present recording uses the same cast and performers. The libretto, in my view the work's weakest point, is by Lady Maie Casey; anyone who tends to squirm at a show of patronising racism would be well advised not to read the text, included with the disc.

I have been one of the fortunates who got to know Margaret Sutherland and her music a couple of decades ago; I have never ceased to admire her, her craftsmanship, musicianship and highly personal, precise style. All these are well to the fore in the score for this opera. As James Murdoch points out in his cover-notes, the composer's achievement, while using only ten instrumentalists and four singers, is masterly and remarkable.

In fact, if not in name, this is a true chamber opera and one of my greatest regrets is that the recording cannot make the choreography as vividly known to us as it does the sound — more especially that of the brilliantly played didjeridu which, incidentally, has been surprisingly well recorded.

The singers, particularly mezzo Genty Stevens as Daisy Bates, cope with the spare score quite admirably and successfully convey the work's limited dramatic content. Musically, after the composer, principal credit must go to conductor Patrick Thomas.

I am aware that this opera presents some rather unusual problems in presentation, but believe that listeners will find themselves richly rewarded if they will concentrate on the music which ranges from the colourful to the very moving. It is sad to realise that, in her long creative life, Margaret Sutherland has written no other stage work; we must be doubly thankful then that E.M.I., with Commonwealth assistance, have made this work accessible to us and in so splendid a fashion.

★ ★ ★

**DEBUSSY — Preludes, Books 1 & 2. Dino Ciani, piano. D.G.G. stereo 2530 304 & 2530 305.**

In fifteen years of reviewing records, this is the first time I've had an opportunity of hearing the whole of the 24 Preludes played by one pianist, at one sitting. And I found it a very instructive experience. As a rule, one hears two or three of the old favourites from Book 1 — the "Girl with the Flaxen Hair", "The Sunken Cathedral", perhaps "Minstrels". More rarely, one might hear the whole of Book 1 — perhaps in Walter Gieseking's exquisite interpretations.

The fact of the matter is that, with the possible exception of "Ondine" and "Feux d'artifice", the second set of Debussy's Preludes remains almost wholly unknown, both to listeners and to the bulk of practising pianists. This set of recordings — one I'm willing to recommend on just about every score — goes a long way to explaining the puzzling neglect of Book 2.

Students, later turned into performers, are given a certain and very binding assessment of Debussy. They are told of impressionism as a kind of reaction against romanticism, a new art form all on its own.

A study of Debussy shows that this is a lot of nonsense. Impressionism, as it was practised by Debussy (and by Delius, among others) was an extension of romanticism and the Preludes of Book 1 are thoroughly romantic pieces of music — which, in part, explains their perennial appeal to concert pianists. They are much beloved by the nodding ladies who remain our box-office regulars and they are laden with emotion and easy on the mind.

I do not want to imply that the Preludes of Book 1 are shoddy — far from it: whether you think of them as romantic or as impressionistic, they are among the greatest music in the piano literature.

However fine these pieces may be, they are not, believe me, superior to the rarely played ones of Book 2. The second set of 12 is less obvious, of less immediate pianistic challenge and of less immediate listener-appeal. To a degree they are less cunning, more easy-going; they include, after all, some humourous and satirical pieces which almost point towards Satie. For all that, the second book of Preludes are by no means easily performed and (as Demus proved) far from negligible.

Dino Ciani, a pupil of Cortot's now in his early thirities, is a new-comer to the Australian market. His playing of the first 12 Preludes, while pleasing, is not entirely convincing and certainly not to be preferred to such classical versions as Gieseking's. It is in the second Book that I found Ciani so very persuasive and, probably, superior to the few others (such as Kars) who have attempted this set. He is helped by an excellent instrument and beautiful recorded sound — but what really matters is the fact that we get to hear a Debussy who is quite unfamiliar and who, one suspects, has been largely ignored by most pianists. A disc of exceptional interest.

★ ★ ★

**HAYDN — String Quartets G major, op.54 No. 1 and C major, op.54 No. 2. Amadeus Quartet. D.G.G. stereo 2530 302.**

It is still far from common to have Haydn quartets released in Australia and this issue is particularly welcome, as neither of these works are currently available in any other version. There was a good recording of the three quartets in opus 54 by the Allegri and a far less satisfactory one by the Juilliard Quartet, but both of these seem to have been deleted some time ago.

On this occasion, I would have welcomed some hint from D.G.G. on when the recording was made — strangely, there was a previous recording of the G major quartet, also by Amadeus, which D.G.G. issued over a decade ago. However, both the sound and the quality of the playing are such that the disc is almost certain to be the outcome of a recent recording session. It is only some eight months since we heard this great ensemble playing Haydn in Sydney and their performances on this record are, if anything, superior to what I recall of their live performances.

The quartets of opus 54, more properly identified as Hob. III 57 & 58, probably date from 1788 and they are among the most generally joyful and affirmative of Haydn's works written during a period when the tedium of being a court musician at Esterhaz is known to have weighed quite heavily. Both quartets, apart from their beauty, are remarkable for the attempts at musical nonconformity which they contain.

These are indeed lovely works which one gets to hear all too rarely and I venture to forecast that we will not hear them to greater advantage than is here possible.

★ ★ ★

**GREGORIAN CHANT — Choir of the Benedictine Monastery at Maria Einsiedeln. Archiv stereo 2533 131.**

This disc, the first of a planned series to deal with the Gregorian repertoire and its several regional conditions, contains four of the "Proper" Masses — Christmas, Epiphany, Resurrection and Ascension — from the 10th-century Index of Einsiedeln, the monastery in Switzerland where this recording was made.

Medieval liturgical music is not, of course, every listener's meat and I would expect few record collectors to rush this disc. For those few, the dedicated few who, irrespective of religion and liturgic content, really care for old music, this will be a rare

Julian Russell will be overseas for the next few months, and in his absence, Classical Recordings will be reviewed by Paul Frolich.

## CLASSICAL RECORDS

find. As far as anyone can say with certainty, the music has been skilfully and faithfully reconstructed; the singing is sonorous and beautiful and it has been recorded with fine resonance.

Listeners who are not thoroughly familiar with Gregorian Chant — the examples on this disc follow Roman ritual — should be warned to take it in small doses for a start, otherwise they may be irritated by the (only apparent) sameness of the chanting. This is a recording no student of musical evolution can afford to ignore.

★ ★ ★

**SEMPRINI PLAYS SCHUBERT, MENDELSSOHN, MOZART — with the New Abbey Light Symphony Orchestra, conducted by Vilem Tausky. Columbia Studio 2 Stereo 394.**

To announce that "Semprini plays Schubert, etc . . ." is a trifle misleading; what they ought to say is "Semprini does for Schubert, etc . . ." because this recording comes as close to musical mayhem as I ever want to venture.

One must presume that Mr Semprini (I've never heard of him as a concert artist) fancies himself as a piano-player and he can, indeed, play the piano. As most of the gook on this disc is "arranged" by himself, the composers named in the heading are exonerated, but there seems no reason to suspect that he could play any music of theirs as music.

The closest Semprini comes to a straight performance is in Mozart's "Turkish March" and that is pretty lamentable. For the rest, forget about Mozart, Schubert and Mendelssohn and settle down to some fairly innocuous Palm Court noises; they have been quite excellently recorded.

★ ★ ★

**VIENNESE DANCES FROM THE BIEDERMEIER PERIOD. Ensemble Eduard Melkus. Archiv stereo 2533 134.**

At times, in the past, Archiv productions have seemed just a little twee, but if they are going to be of the robust and overwhelming charm of this one, they'll yet finish up as best-sellers and popular favourites. The Biedermeier period is the time between 1815 and 1848 when the Viennese middle-class became emancipated and dived, head-first, into the life of pleasure previously reserved to the aristocracy.

Among these pleasures, in addition to wine, food and colourful apparel, was public dancing and every composer worth his salt contributed to the citizens' explicit requirements if he wanted their support in more serious endeavours.

Willingly or otherwise (one suspects the former) Beethoven contributed amply in this cause and the present disc includes his "Modlinger Tanze" of 1819, written for a group of itinerant village musicians. These, like Lanner's "Hungarian Galopp" of 1835 and the anonymous "Viennese" Polka from Linz of 1920, are quite infectious and delightful.

The most important item on this disc, by my lights, is a set of Schubert's, consisting of 5 minuets and 6 trios, written in 1813 and

scored for string quartet — yet another of the composer's many works written for the delectation of his friends and for domestic music-making. With many a foretaste of the late quartets, these beautifully constructed dances are Schubert at his best and most endearing.

In addition to the works already mentioned, there are some brief Schubert Landler for violin-duet, a very fine set of German Dances by Moscheles, dating from 1812 and a simply marvellous waltz by Michael Pamer who, all unbeknown to me, was apparently the true father of the Viennese waltz.

The playing of the ensemble — strings, guitar, flutes, oboes, clarinets, etc, in various small combinations — is quite as exquisite as the music itself; the sound, recorded just over a year ago in the Palais Schonbrunn in Vienna, is quite excellent. This may not be an "important" release, but it is the most enjoyable one I've heard in many months of listening.

★ ★ ★

**BERLIOZ — Symphonie Fantastique. Vienna Philharmonic Orchestra, conducted by Pierre Monteux. Decca stereo SPA 222.**

This re-issue in the "The World of the Great Classics" series is, of course, to be regarded as being because of Monteux rather than Berlioz. Indeed, the "Fantastique" has been recorded so many times (a recent Schwann catalogue lists 22 stereo versions!) that no one should be anxiously looking for more.

This recording was first issued by RCA Victor in 1960 and, Monteux being very famous for his Berlioz readings, was received with great enthusiasm. On a pre-war album of 78's, this conductor had immortalised a superb performance of this same work; by the time he made this later version, Monteux was 85 years old and had lost some of his earlier vigour. At the same time, he gained in lyricism and even after all these years, I still find this quite an exhilarating version of the old war-horse.

The devious ways by which an old Victor classic becomes a Decca release are, of course, beyond me. I presume Deccca have gone back to the original tape and processed afresh; at any rate, the sound is pretty good and does not really betray the age of the recording. My only reservation is about the booms which occur at several fortissimi; these are not very obnoxious, all the same and do not spoil one's enjoyment of a very fine recording of historic and musical value.

★ ★ ★

**VICTORIA DE LOS ANGELES — Songs by Schubert, Brahms, Faure, Debussy, Granados, Rodrigo, Montsalvatge, Nin, Mompou & Valverde; accompanied by Gerald Moore and Gonzalo Soriano. H.M.V. Concert Classic stereo SOXLP 30147.**

On the occasion of this great singer's 50th birthday, E.M.I. give us this welcome sampler of some of her most beloved works taken from recital discs made between 1961 and 1967. This is not the kind of record intended to make one conscious of changes in the singer's voice or even in her style — it is meant for joyful listening alone, and that it guarantees.

Depending on each listener's personal tastes, some tracks will please more than others. Despite a lovely technique and utter sensitivity, I have never thought of Victoria de los Angeles as much of a lieder singer; the five Schubert and Brahms songs are indeed fine, but they lack that final conviction which a singer of native German can bring to them. On the other hand, her Hahn — "Le Rossignol de Lilas" — is simply exquisite and makes one wish for more of this composer's unfashionable chansons.

The Faure and Debussy items, also, are such as to show this singer's voice and deep understanding to their fullest advantage and all these songs further serve to remind us of Gerald Moore's great artistry. It is noteworthy that, in a recent interview, he again refers to los Angeles as one of his three favourite singers.

Side 2, all in Spanish, is sheer joy in music-making. It includes some of the greatest favourites such as Rodrigo's "De los alamos vengo" and the glorious Montsalvatge lullaby — but, really, they are all favourites and flawless.

The Spanish material is made the more interesting in that it also demonstrates the art of Soriano, who died about a year ago. Though much more restrained than Moore, he contributed a great deal to this singer's success, most noticeably perhaps in the delightful "Clavelitos" which I've come to think of as his and the singer's Theme-tune. In the final item, "Adios Granada", Victoria de los Angeles accompanies herself on the guitar, capably as ever.

Despite a few minor lapses, as must befall any singer at times, listening to this record is indeed a great pleasure.

★ ★ ★

**C.P.E. BACH: Concerto for flute, strings & harpsichord in D minor; J. J. QUANTZ: Concerto for flute, strings & continuo in G major. Abbie de Quant, flute; Amsterdam Philharmonic Orchestra, conducted by Anton Kersjes. H.M.V. stereo OASD 7571.**

Although this is, in every respect, a first-rate event, I cannot help wondering how long it will be before listeners and record-collectors get tired of the endless stream of baroque music.

As it happens, both these concerti are good ones and well played — not all of the baroque music being released is of so high a standard. Even at that, however, they are not really unlike a great many other works of the period and, to cap it, both have been recorded before.

The C.P.E. Bach concerto, of about 1770, is a lovely virtuoso work. The performance on this disc is based on Kurt Redel's recent edition and is almost identical with a performance recorded by Redel a few years back. The main difference is in the solo playing where Miss de Quant delivers a far more exciting interpretation.

The Amsterdam Philharmonic, directed by Kersjes, play amiably and extremely well though, one feels, a little phlegmatically for music which can sound quite exciting in the right hands. In both the Bach and the Quantz concerto, orchestra and conductor seem unduly self-effacing, certainly so by comparison with the brilliant and ebullient flautists. As far as I am concerned, a little restraint is certainly preferable to excessive showiness and I am quite happy with these performances — but I know that some others will not feel as I do. The recorded sound and balance are admirable and the disc is a fine one in every important respect.

★ ★ ★

**MUSIC FROM WALT DISNEY'S FANTASIA — BACH: Toccata & Fugue D minor — Kingsway Symphony Orchestra, conductor & arranger Camarata; DUKAS: The Sorcerer's Apprentice — London Philharmonic Orchestra, conductor Bernard Herrmann; MUSSORGSKY: Night on the Bare Mountain — London Symphony Orchestra, conductor & arranger Leopold Stokowski; PONCHIELLI: Dance of the Hours — London Festival Orchestra, conductor Stanley Black. Decca stereo PFS 4260.**

Just after the war, when music was one of many scarce commodities, "Fantasia" burst upon us with terrific impact and many a teenager of the forties was initiated into "serious" music by this film. It all seems a little odd in retrospect — even then, a few of us protested against Stokowski's way of popularising "good" music — but nostalgia will have its way and I certainly would not claim that this disc is at all objectionable or, by current standards, even in particularly poor taste.

Camarata's orchestral version of the organ Toccata & Fugue differs by very little from the well-remembered one of Stokowski — this and the rest of it sounds just as it should. The important thing is that it all sounds a great deal better than it did on the soundtrack. Decca's "Phase Four" is truly brilliant and very exciting and nowadays every one of us has, I think, far better reproduction facilities than were available to a movie-house a quarter of a century ago.

At any rate, this is good fun, well played and a marvellous hi-fi demo item.

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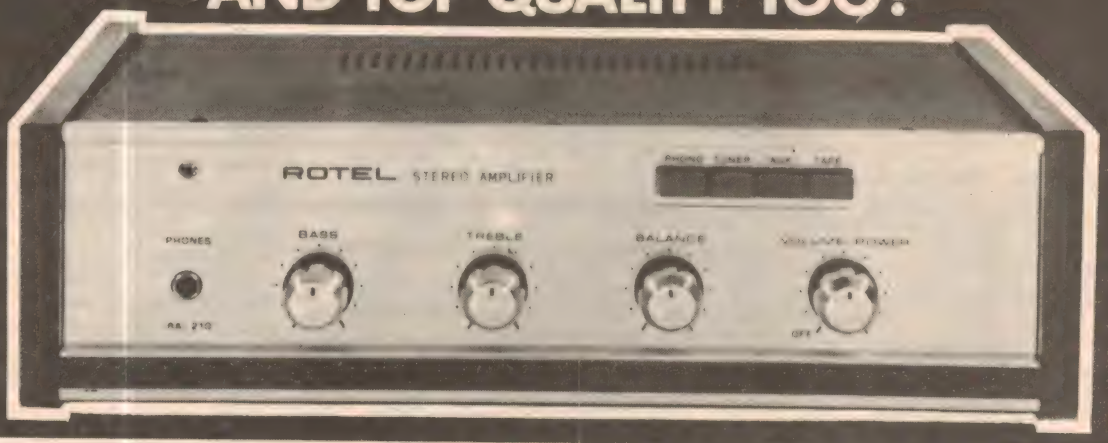


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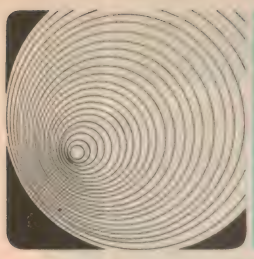

# VARIETY FARE

REVIEWS OF OTHER RECORDINGS

## Devotional Records

**THE EVERLASTIN' LIVING JESUS MUSIC CONCERT. Stereo, Maranatha Music HS 777 / 1. (From S. John Bacon Publishing Co, 119 Burwood Rd, Burwood Vic 3125.)**

I gather from the jacket that this is a presentation by a youth group connected with Maranatha Music in Costa Mesa California, who seek to present the Gospel message by means of their music. The purchaser of the record is invited to respond if they would like a concert arranged in their area.

The lyrics in the album are printed in large type across the centre of the double fold album and, in the sentiments expressed, are traditionally evangelical. But, while Moody, Sankey and Alexander would have been at home with the words, they would have been less at home with the musical style. It is by youth for youth and, while it is fairly restrained I was content to listen to it once only. But then, as a wrinkly, I'm not in the target audience!

The track titles: Little Country Church — In Jesus' Name — Something More — Two Roads — Holy, Holy, Holy — The Shepherd — Jesus — Behold I Stand At The Door — If You Will Believe — Marantha — For Those Tears.

You like guitars? Rock format? Mod vocal style? Youth Group arrangements? Evangelical lyrics? Then this one would be for you. (W.N.W.)

★ ★ ★

**BACH SPECTACULAR. Phase 4 Stereo Concert series; Camarata conducting the Kingsway Symphony Orchestra and Chorus. Leslie Pearson, organ. Decca PFS-4261.**

Transcribed by Camarata and performed with the abovenamed orchestra and chorus, this album provides thoroughly enjoyable listening. To be sure, the selections have been heard over and over but that didn't prevent me from reacting warmly to this latest release. There are six tracks in all, each one the subject of an individual jacket note: Toccata and Fugue in D Minor — Jesu, Joy Of Man's Desiring — Ave Maria — Brandenburg Concerto No. 2: Allegro Assai — St Matthew's Passion: Final Chorus — Air From Suite No 3 in D Major — "Sleepers Awake" — Magnificat: Final Chorus.

Recorded using Decca's Phase 4 technology, the sound ranges from delicate to massive but it is always clean and free from distortion. Because of its content and its likely appeal to the particular listener group, I have included this one in the devotional section. I recommend it to you. (W.N.W.)

★ ★ ★

**BORN YESTERDAY, The New Folk. Stereo, no separate brand, no number. (From S. John Bacon Publishing Co, 119 Burwood Rd, Burwood, Vic 3125).**

According to the accompanying literature, there are two "New Folk" groups, one doing the eastern campus circuit, the other the western, but each concentrating on propagating the Gospel message through their music. The personnel change according to college course demands but the message and the standard of presentation remains constant.

And the standard is very high indeed, as evidenced by a study of their sound here and by the fact that the present disc carries a "Billboard" special merit gold sticker.

What is presented is a varied Gospel concert program which contains elements of jazz, folk, folk rock, Brazilian and what is referred to in the notes as "baroque madrigal." Musically it is well done and very well recorded, with loads of stereo separation. Overall, the emphasis is on the music rather than the lyrics. I doubt that the titles will mean a great deal to you but here they are anyway:

Jordan's River — Love Comes Down — Blues To Sandi — Come The Day — Come With Me — Let's Get Together — Help Me Change The World — Redeemed — Windy, Never My Love — He's Everything To Me — Born Yesterday.

As you will have gathered, the material is aimed squarely at the campus age group and it is to this group it will have its major appeal. But, by any standards, the New Folk must be judged as good at their thing . . . very good! (W.N.W.)

## Instrumental, Vocal and Humour

**A CLASSICAL SHOWCASE. Golden Hour presents. Alshire stereo GH804. Distributed in Australia by Radio Corporation Pty Ltd.**

That recent television commercial showing a bird in flight and then fading to a shot of a climbing airliner has certainly done much to popularise "Morning Mood" from the Peer Gynt Suite. This is just one reason why this "Golden Hour" presentation is sure to sell well. As the name implies, it lasts for just over an hour making it good value. The first half is devoted to tunes from the Peer Gynt suite, played by the Hamburg Staatsoper Orchestra.

Side Two features Dukas' "Sorcerer's Apprentice" and Ravel's "Bolera" played by the London Philharmonic Orchestra. Manuel de Falla's "Ritual Fire Dance" played by the Nord Deutsches Symphony Orchestra concludes the album. Sound quality throughout the album is very good and surface noise was low. Needless to say, the performances left little to be desired. (L.D.S.)

★ ★ ★

**GUITAR SPECTACULAR. Lennie Hutchinson Live EMI Stereo SOELP 299.**

There is something for everyone in this very pleasing local recording from EMI. The featured artist hails from New Zealand and, with an extremely competent backing group, swings his way through fifteen hits ranging from Guitar Boogie to Edelweiss.

Other titles include; Forty miles of bad road — Tea for Two — Lara's Theme — If I were a rich man — Tzena Tzena Tzena — More — The girl from Ipanema — Never on Sunday — Theme from Zorba the Greek.

The other personnel involved are Ned Sutherland, rhythm guitar; Doug Gallacher, drums; Darcy Wright, bass; Milton Saunders, Piano and organ.

This would make an ideal party record, with a variety of tempos ideal for dancing, or as a pleasant background sound. With an impeccable recording quality, it was a pleasure to review. (N.J.M.)

★ ★ ★

**HEAR AND NOW. Ferrante and Teicher, with orchestra conducted by Arnold Eidus. Stereo, United Artists (Festival) UAL-34801.**

From the left and right-hand positions on the stereo sound stage, Ferrante and Teicher swap the lead role against a predominantly string orchestral backdrop. Why did I keep thinking, as I listened, of Liberace and the 101 String orchestra? But it's all very tuneful: American Pie — The First Time I Saw Your Face — Lean On Me — Diary — Tranquillo — I Don't Know How To Love Him— Song Sung Blue — Day By Day — Everything You've Always Wanted To Know — Candy Man — Oh To Be Young Again — Go Away Little Girl.

The quality is very clean and the stereo spread is used to the full, particularly in "Everything You Wanted To Know". Pleasant tuneful sound. (W.N.W.)

★ ★ ★

**HAWAIIAN DANCE PARTY 2. Jim Jensen's Hawaiians. W & G stereo 25 5 5581.**

Apparently, Jim Jensen's Hawaiians are a local group, for the disc was produced in Melbourne. Which just goes to show that you don't have to be Polynesian to turn out the idyllic music of the islands.

The disc is all instrumental with traditional arrangements, although an

**Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).**

## VARIETY FARE

electric organ does provide a small departure from the instrument line-up of a Hawaiian music combo. The music is eminently listenable throughout the disc and is ideal for setting a relaxing mood on the weekends. Sound quality is average and my sample was not entirely free of surface crackles.

Twelve tunes are featured: Malahine Mele — White Gingerblossoms — Goodbye Hawaii — Moon of Manakoora — Harbour Lights — Hula Time — My Tane — Adventures in Paradise — Pagan Love Song — My Isle Of Golden Dreams — Tiny Bubbles — Hula Blues. (L.D.S.)

★ ★ ★

**BEAUTIFUL SUNDAY. Duo Moreno Live at Villa Borghese. W & G stereo 2 / 25 / 5592. 2-record set.**

Villa Borghese is a flash restaurant set on a farm in the foothills of the Dandenongs near Melbourne. And Duo Moreno is the Italian duo who provide the lively dance music. Cesare and Sandro Moreno are as lively and listenable a dance combo you could find in any high class restaurant anywhere around the world. If the food is as good as the music, they must do a roaring trade.

Sound quality is generally very good but some low frequency rumble may be noticeable on some tracks on a system with extended bass response. If you want to sample it, try side one.

Some of the tracks featured on the four sides are; Sha La La La — You're Such A Good Looking Woman — The Song Of My Life — Castaschock — Ten Guitars — Aquarius — Let The Sunshine In — Beautiful Sunday — Cha Cha En Paris. (L.D.S.)

★ ★ ★

**BANJO SPECTACULAR. Ron Carson. Stereo, EMI Series 299, SOELP-9950.**

In this performance, recorded before an obviously appreciative club audience, Ron Carson teams with Jack Allan on piano, Darcy Wright on bass, Barry Stewart on drums and Clair Bail on clarinet and tenor sax. It's all very bright and happy with the audience chiming in occasionally and shouting encouragement during the breaks.

And with old chestnuts like these, what else could you expect? Cabaret — A Four Leaf Clover — Bye Bye Blackbird — Carolina In The Morning — Swanee — Peg O' My Heart — Bye Bye Blues — Toot Toot Tootsie — To Old Shanty Town — Side By Side — Shine On Harvest Moon — Mame — It Had To Be You — Have Nagila.

Live performance or not, the recording is good with plenty of stereo spread and the jazz format should have its own appeal. But, if you're allergic to continuous banjo you'd better listen to a couple of tracks before you put your money on the counter. (W.N.W.)

★ ★ ★

**I'M GETTING SENTIMENTAL OVER YOU. Tommy Dorsey and His orchestra, with Frank Sinatra. RCA Camden CXS 9027. Two record set $5.25.**

A very boyish Frank Sinatra is depicted on the jacket of this album of hits from the thirties and forties, together with the Dorsey vocal group, the Pied Pipers.

Considering the age of the masters used in making these records, the engineers have done a worthwhile job. Nineteen tracks, together with the date of the original recording and the playing time, are listed. They include: I'm getting sentimental over you— I'll never smile again — Sleepy Lagoon — At sundown — Song of India — Tea for Two — Stardust — Quiet Please — Boogie Woogie — Royal Garden Blues — Opus I.

This was an album I enjoyed reviewing and if you can remember the heyday of the big bands, you'll enjoy it too. (N.J.M.)

★ ★ ★

**50 HAPPY YEARS OF DISNEY FAVOURITES. Disneyland Stereo TVSS II EMI Release.**

Twenty soundtrack favourites from such Disney films as Pinocchio — Snow White — Peter Pan — Jungle Book — Song of the South — Cinderella — Alice in Wonderland — Mary Poppins —Bambi — Winnie the Poo — Lady and the Tramp — Bedknobs And Broomsticks and The Three Little Pigs, make up the content of this record. It would be a good reminder for those of us that remember some of the earlier Disney epics as well as a good singalong record for the lollypop set.

Set sound quality is variable with a remarkable lack of treble but those with pleasant memories of Disney films will forgive this. (N.J.M.)

**WINGS. Michel Colombier. A & M stereo SAML 934185.**

Anybody who has heard of "Wings" will probably connect it with Paul McCartney but this album has no connection with him. Instead, it is the brainchild of Michel Colombier. And I mean brainchild. Michel Colombier is one of France's premier composer-arranger-musicians and the musical experience he has put together on this disc has to be heard to be believed. It is really incredible.

It is difficult to catalogue this album. It is really a combination of pop and classical, jazz and folk. Some of it is like "Love 200" by Peter Skulthorpe. Its emotional effects are no less easy to describe.

Imagine music that takes you by the scruff of the neck and wraps you around a telegraph pole. Music with a massive impact. Drive. Emotion. Power. That's what it's like. Some of it is almost Wagnerian in scale. Tremendous.

And range. It ranges from strangely oriental to naked rage and back to fair beauty. Not to be listened to everyday but just every so often. Pop musicians will undoubtedly try to imitate it but will inevitably produce a mass of mediocrity instead. Some will hate it. Many will say it's too heavy. I'm not even sure I like it myself.

The performers are a line-up of musicians from the Paris Opera and Opera Comique of Paris Symphony orchestras, Lani Hall, recently of Brasil '66, Vermettya Royster, lead singer of "Sisters Love" (A & M records), Paul Williams, Bill Medley, razor voiced singer of Righteous Brothers fame plus a 25 piece pop orchestra and chorus. Sound quality is at times shattering. Unreal.

Coming down to earth, there is some tape hiss. If you want to sample it, listen to the instrumental "Pourquoi Pas?" and any of the songs. The words are in the album. (L.D.S.)

★ ★ ★

**REMEMBER WHEN. Nostalgia Sampler. MCA Astor MCAS-002 (Stereo???).**

If you can remember Bobby Breen and his "Rainbow On The River", then you're in the target audience for this "nostalgia sampler". It's very old material dubbed on to a so-called stereo LP and it sounds as one would expect: very little surface noise, but very little treble either and musically stilted. But these were notable performances in their day and, apart from their nostalgic interest, they could provide an interesting conversation piece:

Rainbow On The River (Bobby Breen) — Over The Rainbow (Judy Garland) — Falling In Love Again (Marlene Dietrich) — Marta Rambling Rose (Arthur Tracy) — Let Me Sing And I'm Happy (Al Jolson) — Now's The Time To Fall In Love (Eddie Cantor) — Where The Blue Of The Night (Bing Crosby) — Thanks For The Memory (Bob Hope, Shirley Ross) — Whiffenpoof Song (Rudy Vallee) — Inka Dinka Do (Jimmy Durante) — Girl On The Police Gazette (Dick Powell) — The Philosophy Of W. C. Fields.

Feeling nostalgic? Well, MCA / Astor have tempted you. (W.N.W.)

## Switched on Classics

**THE CLASSICAL SYNTHESISER, Great composers interpreted by the Moog Synthesiser. Interfusion (Festival) Harlequin Series stereo ITFL-1009.**

If you liked "Switched-on Bach"—and most people certainly did — you could hardly fail to enjoy this new Interfusion release. Recorded on the RPM label in South Africa, the whole thing was performed by Mike Hankinson on a standard VCS3 synthesiser, using only a four-track recorder. But what a job has been done with these limited facilities!

Before reading the notes, I fed the disc into a quadraphonic set up, to be greeted by the most convincing and entertaining surround sound. Reference to the notes revealed later that the producers were well aware of its 4-channel potential.

It is Moog sound but modulated deliberately to relate to the items presented: Toccata and Fugue in D Minor (J. S. Bach) — Variations "Mein Junges Lebe hat ein End" (Sweelinck) — Sonata in D Major (Scarlatti) — Sonata Rondo (Muzio Flement) — Concerto in A Minor (J. S. Bach) — Eine Kleine Nachtmusik (Mozart) — Italian Concerto (J. S. Bach) — Moonlight Sonata (Beethoven).

Chestnuts? Maybe, but their very familiarity will make you appreciate all the more the totally new sound which Mike Hankinson wins from his synthesiser. I have no hesitation in recommending this one. (W.N.W.)

## VARIETY FARE

**CHRIS BARBER & HIS JAZZ BAND. Petite Fleur Marble Arch Stereo GGS 1365 Astor release.**

Ten all time favourites make up the roll call on this disc of trad jazz in the Barber style. The title track leads off, followed by: High Society — Everybody loves my Baby — Bugle Call Rag — Hushabye — Whistlin' Rufus — Tuxedo Rag — Majorca — I can't give you anything but love — When the Saints go marching in.

I don't know that 'electronically created stereo' does anything for a record originally put down in mono; perhaps there is an increase in the width of the sound image. But despite this personal qualification this is a very easy-to-learn-to record. (N.J.M.)

★ ★ ★

**THE BEST OF BURT BACHARACH. Sceptre Records stereo CTN 18012 Musicassette BCT 5148.**

If you are in the market for a collection of Bacharach songs then you may as well buy them as a collection of vocals, sung as they were originally sung. Instrumental versions of Bacharach songs are generally flat and insipid, to my mind. Dionne Warwick, B. J. Thomas, Buddy Greco, Tommy Hunt, Chuck Jackson and the Shirelles are the artists featured on the disc. Dionne sings "Anyone Who Had a Heart", "Make It Easy On Yourself", "Message to Michael" and "Walk On By." The other songs are well presented by the remaining artists.

Sound quality is okay but playing time is short with a total of 33½ minutes.

Remaining tracks are: Everybody's Out Of Town — I Just Don't Know What To Do With Myself — It's Love That Really Counts — I Wake Up Crying — Close To You — Any Day Now — Baby It's You — There's Always Something There To Remind Me. (L.D.S.)

★ ★ ★

**HAIR, The London Theatre Ensemble and Chorus. Somerset Stereo 693.**

This performance of the "rock" musical is much more subdued than some of those we have become accustomed to. As well, the diction is well nigh perfect and it's the first time I've been able to understand all the lyrics. The record has all the hirsute hits, fourteen of them in all, so if you missed out on buying the performance when it was "the" thing, here's your second chance. (N.J.M.)

★ ★ ★

**POURCEL TODAY, Franck Pourcel and his Orchestra. Columbia Stereo SOEX 9965 EMI Release.**

I tend to regard Franck Pourcel as a Gallic Enoch Light, with his very vivid treatment of recorded music. That comment aside, we have twelve well orchestrated renditions of recent hits, some of them film themes:

San Francisco — Puppet on a String — The World We Knew — Casino Royale — The Last Waltz — Aranjuez Mon Amour — You only live twice — A Man and a Woman.

The quality is good with effective stereo spread; a good record to demonstrate your hi-fi gear. (N.J.M.)

**TWO GUITARS FOR TWO IN LOVE. Tony Mottola, Project 3 stereo PJL 34829.**

Tony Mottola can certainly play a smooth and melodic guitar. On this disc he's so smooth it's like listening to a thirteen track version of "Sleepy Lagoon" — far better than barbiturates and definitely not addictive. Sound quality, for those still awake, is good.

A list of the tracks reads: It Had To Be You — Go Away Little Girl — Cherry Pink And Apple Blossom White — Li'l Darlin'— Girl Talk — Till There Was You — Satin Doll — Don't Blame Me — And I Love Her — Violets For Your Furs — Soon It's Gonna Rain — My One And Only Love — For Two In Love. (L.D.S.)

★ ★ ★

**YOU'RE A LADY. The 50 Guitars of Tommy Garrett United Artists UAL-34807 Festival Release.**

Subdued background or dining music would be the best description of this collection of recent hits with the pleasant sound of the Tommy Garrett group.

The list includes; Alone Again — More — A very precious love — Something — You're a Lady — Girl Talk — A taste of honey — Lovers — For the good Times.

Although it is not mentioned, there are sounds on some tracks that sound very much as though a synthesiser has been used, to good effect. The sound quality is good, with moderate stereo spread. (N.J.M.)

★ ★ ★

**GREAT WESTERN THEMES. The Dimensions in Sound Orchestra Astor Stereo GH 809.**

I found my record player full of dead cowboys and Indians after listening to this catalogue of Western movie and TV themes but it makes good listening, with most of the twenty-one tracks given the 'wide screen' treatment. There are old favourites like: The Big Country — The Virginian — The Good, the Bad and the Ugly — High Noon — Gunsmoke — Wagons West — The Sundance Kid — High Chaparall — Cornbelt Medley — Cade County — Ballad of Paladin.

The sound quality is good, well worth a hearing. (N.J.M.)

★ ★ ★

**ON STAGE. Benny Goodman sextet. Decca stereo DKL 4-1 / 2.**

Benny recorded this last year in Copenhagen. With him were Zoot Sims (saxophone), Bill McGuffie (piano), John Pizzarelli (guitar), Harold Gaylor (bass), Elmer Alexander (drums) and Peter Appleyard (vibraphone).

Benny plays all of the old numbers of years ago.

His playing still has a somewhat dry quality but he improvises as deftly as ever. (G.W.)

★ ★ ★

**101 STRINGS PLUS GUITARS, Arranged by Monty Kelly. QS quadraphonic, Astor Gold, QS-11.**

Six guitars plus percussion give this disc a contemporary mood although, on side 2 in particular, the balance seems to swing back in favour of the strings. I can foresee the respective sides being preferred by different members of the household, depending on their age group.

The tracks: Girl From Ipanema — Guantanamera — When Will We Know — Cast Your Fate To The Wind — Malibu Sun — Call Me — A Man And A Woman — Maria, Maria — Yellow Bird — Rio Del Mar.

The balance is good and, if you have a quad system, it will surround you with strings of one kind and another. But, of course, you can enjoy it in 2-channel stereo if that's what you have. Like all the other matrix discs, it is substantially compatible. (W.N.W.)

★ ★ ★

**EVENING AT POPS, featuring Tubby The Tuba. Arthur Fiedler and the Boston Pops Orchestra. Stereo, Polydor 2391-039.**

Virtually the whole of side 1 of this disc is taken up with the musical fairy tale, narrated by Julia Child, telling how Tubby the Tuba got to sing his melody. Aimed at the juvenile listener, it is intended to introduce them to the main instrumental groups within the orchestra. A worthy objective, to be sure, but it might have been achieved a little better had there been a little more "presence" to the narrator's voice.

Side 2 is pure orchestra (and good orchestra) with a variety of well known melodies which, by nature, feature particular instruments. This is good follow-up material:

Sesame Street, Theme — I'd Like To Teach The World To Sing — Brand New Key (trombone) — Bugler's Holiday (bugles) — Trumpeter's Lullaby (trumpet) — Jalousie (violin) — Dance Of The Sugar Plum Fairy (celeste) — Dance Of The Toy Flutes — 76 Trombones.

You'll have to be the judge as to whether "Tubby The Tuba" is appropriate to your family circle but there's no hardship in listening to the contents of side 2. The recording quality is good. (W.N.W.)

★ ★ ★

**LET'S FACE THE MUSIC. Matt Monro with orchestra. Stereo, Capital Series 299, SENC-9918.**

It takes only a few spins of the groove to draw attention to the quality of the orchestral recording on this budget priced disc and despite the age of the tracks 1961-6. It is full, clean and smoothly spread across the sound stage. Against such a background, well known singer Matt Monro ranges from a sentimental mood to uptempo in no less than fourteen numbers. They include: Let's Face The Music — Without You — Why Not Now — I'll Dream Of You — Cheek To Cheek — Just Yesterday — Leave Me Now, and seven others.

Fourteen tracks of well recorded sound on a budget album can't help but be good value — provided you like Matt Monro. (W.N.W.)

★ ★ ★

**LET'S GO, Victor Silvester and his Orchestra. Astor stereo SPLP 1403.**

If you like the Latin beat for your dancing or dining, try this record on for size. There are 14 hits, old and new alike: Theme from Hawaii 5-O — Sunny — Makin' Whoopee — Let's Go — Sweet Gingerbread Man — The Fool On the Hill — The Wedding

## VARIETY FARE

Samba — I'd like to teach the World to Sing. Victor Silvester's strict tempo shows through the general exuberance of the recording which is of high quality throughout.

The rhythms include rumba, cha-cha, samba and modern beat. (N.J.M.)

★ ★ ★

**LAST TANGO IN PARIS. Gato Barbieri and his Orchestra, stereo UAL 34838 United Artists Festival Release.**

With all the flap about the film, this recording of the sound track score is something of a letdown.

Most of the tracks sound so alike as to be boring in their repetition. The best description of the music would be 'side walk cafe' style, with eleven tracks including: Last Tango in Paris — Girl in Black — Picture in the rain — Return — It's over — Goodbye — Why did she choose you. The sound quality was average with a few ticks and crackles. (N.J.M.)

★ ★ ★

**ENTRE DEUX REVES. Charles Aznavour sings in French. Stereo. Barclay (Festival) BCL-34640.**

Arranged and conducted by Christian Gaubert and recorded in Paris, this album is as French as the Eiffel Tower. The titles are French as are all the lyrics. Diction is excellent but, in many numbers, it is so fast that your best high school French will be left way behind.

The titles: Emmenez-Moi — Eteins La Lumiere — Adieu — Un Jour — Les Vertes Annes — Je Reviens Fanny — Yerushaliam — Entre Nous — J'Aimerai — Il Te Faudra Bien Revenir — Au Voleur — Tout S'en Va.

The quality is very clean and the surface good. Stereo spreads the backing orchestra, leaving the soloist at centre stage. It's quite pleasant listening but, unless you have a special interest in French songs, I imagine that you would be happier spending your money on something you could understand! (W.N.W.)

★ ★ ★

**THE COUNTRY HEART OF WALTER BRENNAN. Sunset stereo US 96218 Festival Release.**

I liked Walter Brennan as an actor but I find this group of Western style soliloquys somewhat maudlin in their overall treatment.

The sound quality leaves nothing to be desired, with a country style musical and vocal backing on items such as: Cotton-eyed Joe — Old Courthouse — Detroit City — Waiting for a Train — Moon Wanderer — Scarlet Ribbons — Tennessee Stud.

But, if you like this type of program, give the record a hearing. (N.J.M.)

★ ★ ★

**THE ORIGINAL STANLEY HOLLOWAY. His famous adventures with Old Sam . . . The Ramsbottoms. Mono, Columbia series 299, OEX-9910.**

If you can remember Stanley Holloway and his monologues of the 1930 / 40 era, then this record is for you. There are 15 in all, some that you could have remembered without prompting, others that you'll almost certainly have forgotten until you hear them again. They're worth listing:

The Lion and Albert — Albert Comes Back — Albert and the 'Eadsman — Jubilee Sovereign — Albert Evacuated — Three Ha'pence a Foot — Brahn Boots — The 'Ole In The Ark — Marksman Sam — One Each Apiece All Round — Sam's Medal — Sam Drummed Out — Pick Up Tha' Musket — Beat The Retreat On Thy Drum — With 'er 'Ead Tucked Underneath 'er 'arm.

For the price of a budget issue, that's quite a lot of tracks and it's sure fire conversation piece for the fifty and overs. The quality, by the way, is dated but acceptable. Give yourself a dose of nostalgia (W.N.W.)

★ ★ ★

**HEAVEN IS MY WOMAN'S LOVE. Tommy Overstreet. Sterec, Dot (Festival) ZL-24768.**

Now working with producer Ricci Mareno, former C&W singer Tommy Overstreet is in a predominantly sentimental mood with a collection of songs which includes some of successful singles:

Heaven Is My Woman's Love — To Get To You — Your Love Is Just Like Sugar — How Do I Tell You Goodbye — Baby's Gone — Love Don't Live Here Any More — A Seed Before The Rose—Forget Him — I Believe In You — It's Gonna Take A Little Bit Longer — Don't Be Afraid To Give Me Love.

The backing varies with the song from restrained rock through strings to electric steel guitar. The voice is good, the diction is good and, all round, its a pleasantly listenable middle-of-the-road vocal album. (W.N.W.)

★ ★ ★

**DIANA TRASK SINGS ABOUT LOVING. Dot stereo ZL34691.**

To my mind, Diana Trask sings just like Johnny Cash — a sort of real he-man female singer. As such, she seems more at home belting out songs with Mitch Miller than singing about love. Add to that her country and western style and the album becomes pretty monotonous. Sound quality, for what it's worth, is okay.

Ten tracks are featured: It Meant Nothing To Me — A Thing Called Love — Cry — I'm Yours — We've Got To Work It Out Between Us — Livin' And Lovin' Life — Stand By Your Man — How Much More Have I Hurt Thee — Everything I Own — Take Me Home And Love Me. (L.D.S.)

★ ★ ★

**THE IRISH ROVERS LIVE! Interfusion stereo ITFL-1008.**

In spite of the troubles in their home country, the Irish Rovers are as popular as ever around the world. This album was recorded at a live performance at CBC Television Studios in Vancouver and while the sound quality leaves a little to be desired — their microphone technique is surprisingly poor — their natural charm shows through.

Twelve tracks are featured: What Wid Ye Do — I'm A Rambler — Step It Out Mary — We'll Rant And We'll Roar — Sweet Thames Flow Softly — Windy Old Weather — Valparaiso — Lord Of The Dance — Barley Mow — When The Shipyard — Go Back On Full Time — Morning Town Ride — Road To Gundagai. (L.D.S.)

# Jazz and Rock . . .

**SOUNDER. Taj Mahal. CBS stereo SBP 234269.**

Taj Mahal, the black blues singer and player, appears solo for most of the tracks on this LP, taken from the soundtrack of an all-negro movie.

He plays banjo, guitar, harmonica and six-holed fife. The instruments are often used to mimic outdoor sounds. The harmonica solo, for instance, is an impression of a chase by "Sounder" who is a hunting dog.

The music is based on ethnic material and makes interesting and diverting listening. (G.W.)

★ ★ ★

**THE BAND'S ALRIGHT BUT THE SINGER IS GULLIVER SMITH. Reprise stereo RS 4001.**

Smith is the ideas man who was the writer and performer behind the Company Caine LP a couple of years ago.

The band on this LP is basically the Company Caine group. The beat tends to be more in a rock groove. The lyrics, written by Gulliver with Russell Smith cover the transitional period from adolescence to women's liberation.

They are forthright and well rounded. The band is a no-nonsense beat group, almost simplistic in its approach to things like "Such a Shame" which features Dave Conners on tenor sax and Bobby Gebbett on stand-up boogie piano.

Gus McNeil produced the album which was recorded by technicians Bruce Brown and R. Patton. (G.W.)

★ ★ ★

**HOLD ON, I'M COMIN'. Herbie Mann. Atlantic stereo SD 1632.**

The LP was made last year, mostly at the New York jazz festival. Mann continues to grow in stature as a hot flautist. He attacks soul music and rock with the intensity that he used on a ballad.

The flute, normally a plaintive, reflective instrument, becomes a fire-eater when Mann wields it on "Gimme Some of That Good Old Soul Beat Momma."

The other principal solist is David Newman on tenor sax and it is interesting to note Newman modelling his style on Mann in the solo on "Respect Yourslef."

The highlight of the album is a 13-minute version of the Mann specialty "Memphis Underground." Pat Rebillot's electric piano solo might shock some of the jazz diehards but the Newport audience liked it. (G.W.)

★ ★ ★

**ANN ARBOR BLUES AND JAZZ FESTIVAL 1972. Atlantic stereo SD 2-502.**

If you were wondering where blues is at, it's here. The two LPs were part of the goings-on at Ann Arbor U.S. last year when a festival was held to define blues today and to pay tribute to the late Otis Spann.

There are another couple of LPs around from the festival. This one gives a good cross section of what happened.

Blues is undeniably changing, just as the black people, whose musical language it is, are changing. There is the feeling that performers in the traditional style life Muddy Waters and Howling Wolf are hamming it up for an audience which has gone on to other things. When Koko Taylor sings "Wang Dang Doodle" it is a good blues sound but what is the value of underground language, the great double entendre of the blues, in an age when kids use four-letter words in high school papers?

CJQ's "Form Kinetic" a linear jazz piece played by Charles Moore on a slightly flat trumpet is today's underground. It's black language but it is not the 12-bar blues.

Not what we knew and what a few sentimental white folks like me want to listen to for their value as an art from.

Bonnie Raitt (white) was one of the representatives of the completely trad blues style.

One of the most touching tracks of the set is that vocal which Lucille Spann sings to the guitar obbligato of Mighty Joe Young. This is the dedication of the festival to the dead Otis. Lucille doesn't have a pretty voice but her blues is torn right from the heart and ridiculous lines like "he was sweeter than a Georgia peach" come out like the truth. (G.W.)

★ ★ ★

**LAST OF THE BROOKLYN COWBOYS. Arlo Guthrie. Reprise stereo MX 2142.**

After trying to live with the Alice's Restaurant image through a couple of LPs, Guthrie has settled down as a country style performer, a songman and musician in the tradition of American white.

The LP opens with a suite of Irish jigs played on double-tracked fiddles by Kevin Burke.

This sets the tone. The record is sentimental as Arlo sings "Miss the Mississippi and You" with what I call a cowboy band.

The band has guitars, clarinet, Guthrie at piano and a strong close harmony group in the background.

Guthrie plays a fair bit of piano on the disc. The track "Walk on the Rag" is a bright instrumental and on "Cooper's Lament" he accompanies himself on the piano.

The hippie scene seems to have lost another rocker to the wide open spaces and if you doubt the truth of that statement lower the stylus on to Arlo yodelling his way through "Lovesick Blues" in Hank Williams style. (G.W.)

★ ★ ★

**THE BLUES SINGERS 1925-29 Louis Armstrong. Swaggie mono S 1310.**

Louis and the boys did their best to back Lillie Delk Christian, one of the performers on this LP but she was a cabaret performer, not a blues singer and try as they could, Louis and clarinet player Jimmy Noone could do little to jazz up the formality of the occasion. Why the tracks appear on an LP of "blues" singers is a puzzle. Noone is interesting for a few bars but Miss Christian has only one place, on the shelf next to Tiny Tim. Victoria Spivey is heard on two good tracks.

Hociel Thomas, a neice of Sippie Wallace, is in rough form on half a dozen tracks. Interesting if you like following family lines. This LP is strictly for those of esoteric jazz tastes. (G.W.)

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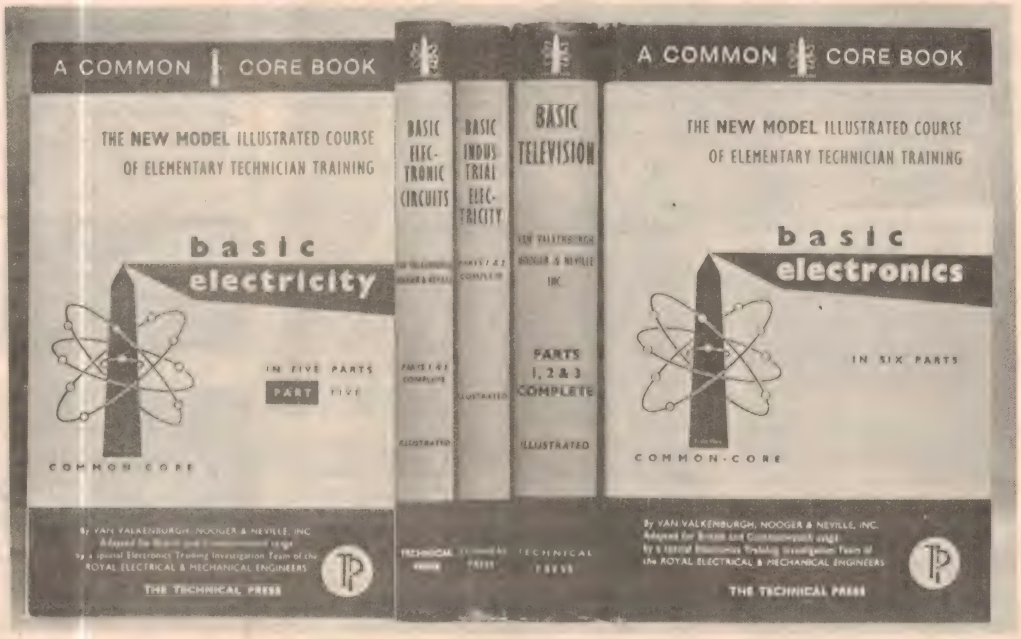


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# BOOKS & LITERATURE

## Electromagnetism

**ELECTROMAGNETIC FIELDS, ENERGY, AND WAVES, by Leonard M. Magid. Published by John Wiley and Sons, Inc, New York, 1972. Hard covers, 165 x 234mm, 781 pp, many diagrams. Price in Australia $18.98.**

An advanced text on electromagnetism, aimed at senior undergraduate electrical engineers and physicists, with the idea that it would form the basis for a two-semester course.

A good idea of the content of the book can be obtained from its chapter headings: 1 — Introduction to Fields and Field Theory; 2 — Electromagnetic Field Laws in Free Space; 3 — Vector Analysis; 4 — The Differential Field Laws; 5 — Static Fields 1; 6 — Static Fields 2; 7 — Macroscopic Fields in Matter; 8 — Electromagnetic Energy and Power; 9 — Time-varying Fields — Low Frequency Behaviour; 10 — TEM Fields and Waves (Lossless Transmission Line Theory); 11 — Plane Waves in Lossless Media; 12 — Radiation.

As indicated by the chapter headings, the book offers a comprehensive coverage on virtually all aspects of electromagnetism. The text is written in concise mathematical terminology, with highly readable discussions on important points. All mathematical concepts are developed in a clear and logical manner, but with every effort made by the author to give the reader a physical understanding of the concepts.

Each chapter concludes with a summary and a set of problems, making it highly suitable for self-tuition.

In summary, a book that may be thoroughly recommended to the senior undergraduate. It should also prove sufficiently challenging to post-graduate students.

The review copy came direct from the local office of the publisher, but presumably the book should be available at all major bookstores. (G.I.S.)

## Radio-teletype primer

**RTTY HANDBOOK, by Wayne Green, W2NSD. Published by Tab Books (Publication No597), Blue Ridge Summit, Pennsylvania, USA, (first edition) soft covers, 136 x 215mm, 320pp, many diagrams and pictures. Price in Australia $7.40.**

Written in an easily read and digested style, this book is an informative addition to the Tab library of topical technical publications. It fills out the range of subjects and covers a need on a subject too often overlooked: radio-teletype or "RTTY."

The book is intended as a primer for recruits to the RTTY ranks of amateur operators, and the subject of frequency shift keying is discussed at some length, as this is the method of modulation normally employed. But besides giving general principles it also gives sufficient practical detail for the more experienced operators to launch into the setting-up of an RTTY station.

The coverage is wide within the limited field involved, as seen by the content of the fifteen chapters: 1-Getting Started in RTTY; 2-Basic Principles of RTTY; 3-Equipment; 4-Terminal Units; 5-Frequency Shift Keying (FSK); 6-Audio Frequency Shift Keying (AFSK); 7-Interconnections and Control circuits; 8-Tuning; 9-Reading and care of tape; 10-FCC Regulations; 11-RTTY Art; 12-Improving Reception; 13-Filters; 14-Auto Start; 15-Accessories. An index is included covering all the main features and items in the text.

The review copy came from the local office of the publisher who advises that copies should be available from all larger bookstores. (F.J.S.)

## Communications advice

**UNDERSTANDING AND USING RADIO COMMUNICATIONS RECEIVERS, by John Schultz. Published by Tab Books, (publication No614), Blue Ridge Summit, Pennsylvania, USA, (first edition) soft covers, 138 x 215mm, 192pp, many circuits and diagrams. Price in Australia $4.95.**

This book is intended for the person who wants to achieve the best performance possible from receiving equipment, regardless of whether he is a hobbyist or professional operator. It provides a description in clear language of the various functions of stages in a communications receiver, what their limits are and how to use them to the best advantage.

It provides a comparison of different receiver types and their merits. Also discussed are aerials for different purposes and suggestions about ways of reducing interference problems to a minimum. Repairs, replacements and maintenance is also discussed.

An emphasis is made on the attitude that although the receiver should provide all that is necessary to ensure good communications, equal regard should be given to the aerials used, frequencies employed, and skilled manipulation of the receiver facilities to provide the optimum results.

A glance at the chapter content will indicate the coverage of the book and the subject treatment: 1-Some Basics on Radio Wave Propagation; 2-Frequency bands and Assignments; 3-Receivers; 4-Survey of Receivers; 5-Obtaining and Using Receiving Equipment; 6-Receiving Antennas; 7-Signal Modulation Methods; 8-Interference; 9-Professional Receiving-Monitoring Installations; 10-Testing and Maintaining the Receiver Installation. An index is included.

The review copy came from the local office of the publisher who advises that copies should be available from all larger bookstores. (F.J.S.)

## Out in the cold

**CRYOELECTRONICS, by W. P. Jolly. Published by English Universities Press, London, 1972. Soft covers, 138 x 216mm, 88pp, diagrams. Suggested price in Australia $4.70 (Hardcover version $8.05).**

A fairly specialised little volume, designed to help working engineers and physicists in keeping abreast of modern developments in the sphere of low temperature electronics. The text is kept simple and straight-forward, with the idea of making it possible to assimilate the material in the shortest possible time.

There are chapters on conductors, semiconductors and insulators at low temperatures, followed by a fourth on superconduction. The fifth chapter then deals with cryotron switches and persistent current stores, while the sixth and final chapter deals with microwave radio effects at low temperatures.

The basic level of the text is at about second-year college standard, but the chapters are provided with references for those wishing to delve more deeply into the various topics. There is a short bibliography at the end of the book, with the same purpose in mind.

For those keen to have a sound background in this important new field, a very valuable little book.

The review copy came from the publisher in England, who advises that copies are available here from Hodder and Stoughton (Australia) Pty Ltd. (J.R.)

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# PRODUCT REVIEWS AND RELEASES

## Dual capstans on new Sony deck

Sony's new TC-161SD stereo cassette deck has just about all the facilities one could desire in this sort of machine. Facilities include automatic stop, provision for both normal and chromium dioxide tape, a limiter, dual capstan drive and Dolby noise reduction.

In appearance, the Sony TC-161SD is very similar to at least one other machine in the Sony range, the TC-165 which we reviewed in November 1972. Overall dimensions are 400 x 127 x 276mm (W x H x D) with the cabinet finished in oiled walnut. Front and rear sections of the control panel have a low-gloss charcoal finish while the remainder is satin "scratch-grain" aluminium.

The front portion of the control panel is stepped to accommodate five piano-key controls, a pause button, two microphone jacks for low impedance mics, a jack for 8-ohm stereo headphones and a two-position switch for headphone volume level. The transport controls are from left to right eject, fast reverse, play, fast forward and record. The normal convention applies in that the record and play buttons must be pushed together for the recording mode.

Immediately above the transport controls is a large STOP button. To the right of the cassette well are switches for Dolby, limiter and tape select (normal or chromium dioxide), two recording level slide controls and a rocker switch for power.

The rear section of the control panel is inclined forward to render the two VU meters easy to read. Also accommodated on this section are the revolution counter and its associated memory switch plus a red recording indicator.

At the rear of the unit is a small panel with four phono sockets (two input, two output) and a five pin DIN socket. A slide switch allows switching between the input phono sockets and the input connections of the DIN socket. Also on the panel is the mains input voltage selector and fuse holder.

All controls have a good positive feel but the pressure required to operate the transport controls is perhaps a little heavier than usual. The two level controls are convenient to use and slide operation is particularly appropriate for this function. Plugging in a microphone automatically cuts out the signal from the appropriate input on the rear panel. Backing up the rev counter facility is a light behind the cassette (in the well) which allows the user to gauge the tape progress even in the dark.

A good feature is the automatic stop facility, which switches the tape transport off three seconds after the end of tape. This prevents unnecessary wear on the mechanism and alerts the user to the end of tape by the audible click from the transport. Allied with the automatic stop is the memory counter facility. By "zeroing" the counter at a particular point on the tape, one can go back to that section at any time merely by pressing the rewind button.

An automatic stop facility of this type is relatively easy to provide on machines with low voltage DC motors, because they already have an electronic speed control system. However the TC161 SD has a high performance AC hysteresis-synchronous motor, so that Sony have had to go to more trouble.

Another of the machine's features is the dual capstan drive, which is claimed to keep the tape passing the heads at a constant tension. This is achieved by driving the capstans at slightly different speeds, via pulleys with slightly different diameters running from a common belt. In theory, it should render the wow and flutter performance less susceptible to the vagaries of cassettes, but means that greater precision in manufacture must be applied to realise the advantage.

In practice, it does appear to have reduced wow and flutter. We did not measure this parameter — it is too dependant on the particular cassette used, and one must use exactly the same method of measurement and interpretation as the manufacturer for the figures to be meaningful. But careful listening tests with familiar cassettes suggested that the deck has a very low wow and flutter level.

Calibrations of the VU meters were reasonably accurate. The limiter, which can be switched on or off, comes into operation at signal levels just below OVU and allows operation with input signals considerably above OVU. It is suitable for general recording, but as it inevitably produces some distortion of transients, the level controls should be conscientiously used for high-quality recordings.

Using conventional low noise tape, we measured the frequency response at a level of minus 20VU and found it within plus 1dB and minus 3dB from 50Hz to 10kHz with a fairly rapid rolloff beyond 13kHz. With chromium dioxide tape, the response was better at plus or minus 2dB from 40Hz to 15kHz; at 16kHz, the level was minus 8dB with respect to 1kHz and rolloff was very rapid beyond that point.

Signal-to-noise ratio without Dolby was minus 42dB with respect to OVU. This is an unweighted measurement and would be considerably improved if low frequency (inaudible) noise was excluded from the measurement. The Dolby circuitry affords further improvement at the higher frequencies and reduces hiss to an unnoticeable level.

Separation between channels with respect to OVU was minus 30dB at 1kHz and minus 15dB at 10kHz, which are typical figures. Distortion at OVU, off tape, was around 5pc, which is a little higher than expected from a machine in this price range. Also we found that for signals above 10kHz of several hundred millivolts into the line inputs, audible heterodyne whistles were recorded onto the tape, even when the recording level was as low as minus 20VU. This indicated an overload problem in the stage before the recording level attenuators.


This was borne out in practice. For best results, recording levels must not "flick over" OVU into the red, otherwise distortion becomes obvious. Further, the line input signal should not be excessive, ie, much above the nominated 60mV maximum sensitivity for OVU, otherwise quality is not as good as it can be. With these provisos and using Dolby and chromium dioxide tape, the TC161SD gives excellent recordings, with little to pick between it and premium quality open-reel machines.

At $360 suggested retail price, the Sony TC161SD is not a cheap machine. But it is capable of fine, troublefree performance so that after six month's use the purchaser will probably think little of the purchase price.

Australian distributors for Sony equipment are Jacoby Kempthorne Pty Ltd, 469-475 Kent Street, Sydney, NSW 2000. (L.D.S.)

# EMI precision receiver uses synchrodyne technique

Those who have built or are building up the synchrodyne tuner described in our March issue should find this product of particular interest. It is a precision monitoring receiver, designed and built by an Australian firm and using the same phase-locked loop IC for synchronous demodulation.

This receiver is a product of the Commercial and Advanced Electronics Division of EMI (Australia) Limited. It is referred to as the Type 80 Precision Medium Frequency Receiver, and is specialised in that it is made for very high quality reception of any one frequency or channel. Although originally designed for the ABC for monitoring their own transmissions, this receiver could be used by anyone wishing to do so, provided the interest was confined to one channel.

The circuit is of all solid state design and fundamentally on the super-heterodyne principle, but with those refinements necessary to meet the requirements of a high quality receiver of wide bandwidth and low distortion.

An RF stage is provided, with three tuned circuits before the mixer. Provision is made for either a balanced or unbalanced aerial system. All three tuned circuits are damped and the latter pair are somewhat over-coupled, to provide adequate bandwidth and still retain ample rejection of unwanted signals.

The mixer is fed by a crystal controlled oscillator to give an IF of 455kHz from the incoming signal, with a high degree of frequency stability. A trimmer is provided so that the crystal may be adjusted precisely to frequency. An important feature of this receiver is that the crystal oscillator and adjustments for the RF tuned circuits are assembled on a separate plug-in printed board. By this means, the receiver may be set to any channel within the medium frequency broadcast band, simply by changing plug-in boards to suit.

Two stages of IF amplification follow and these include two pairs of over-coupled tuned circuits and a single tuned circuit. All are damped to ensure adequate bandwidth.

Two detector systems are available. The output of the last IF transformer feeds a full wave and slightly forward biased diode detector. Another winding on the IF transformer feeds a phase-locked loop using an IC for synchronous detection.

A 10kHz notch filter follows the detectors, and may be switched in and out as required. Incorporated is also a switched audio bandwidth filter with roll-off at 3.5kHz, 6kHz and 9kHz. A fourth position, designated "flat" virtually gives the full transmitted bandwidth of 10kHz.

An audio control sets the level into the audio amplifier, which ends with a complementary symmetry pair, transformer coupled and suited to feeding a 600 ohm line at the standard level. The unit is powered from its own inbuilt power supply.

The VU meter is switchable and may be connected across the output to read the level going to line. Alternatively, it may be switched to measure AGC, with an arbitrary scale, maximum reading corresponding with maximum gain.

The need to meet the basic requirement of an input signal between 1mV and 100mV quickly became apparent after setting up the receiver to evaluate its performance. We are located in the city, where reception conditions are far from good, and an adequate aerial was obviously necessary. Having met this requirement, the station (2FC in this case) came in loud and clear.

It may be worth mentioning that the sensitivity of this receiver is not high when compared with many run-of-the-mill broadcast receivers. However, the role of this unit is such that it will normally be operated in a strong signal environment and in fact, very high sensitivity could be an embarrassment.

player. This is due mainly to the fact that the receiver is restricted to an upper frequency limit of 10kHz; also a little distortion will be inevitably introduced in the transmission and reception processes.

As was mentioned earlier, a diode detector is provided as well as a synchronous detector. Apparently this came about by agreement with the ABC and the receiver designer, being deemed a desirable feature. For monitoring purposes, each detection system has its own characteristics which may be used to advantage where the circumstances call for it.

On a listening test, switching from one detector to the other with the full bandwidth selected, the synchronous detector seemed to be slightly brighter than the diode. Also,

The output straight from the audio amplifier is sufficient for comfortable room listening when driving a 15 ohm speaker system. We did not attempt to make measurements of the performance but were contented to make a critical listening test over a lengthy period so as as to include all kinds of program sources. The impression is that the receiver has achieved what was expected of it. The audio quality is so good that even minor defects in program material quality can be readily detected with a keen ear. Where the material quality is first class, the sound falls only a little short of that obtained from a good record the synchronous detector has the advantage at night in that it suffers less from "monkey chatter" effect.

In short, we found this piece of equipment a delight to listen to. In addition to being useful in the broadcasting industry as a monitor, it may also be a proposition for the private listener who is only interested in one channel and wants nothing but the best.

The unit for review was supplied directly by EMI (Australia) Limited, Commercial and Advanced Electronics Division, 14-18 Parramatta Road, Homebush, NSW 2140. The price is quoted as $487 plus sales tax where applicable. (I.L.P.)

NEW PRODUCTS

## First approval of marine SSB

International Transceivers of Brookvale, NSW, has produced the first marine SSB transceiver to be approved to PMG specification RB211d.

This specification covers all aspects of marine SSB equipment to be fitted to vessels, under the PMG's policy of changing over to single sideband.

"We are proud to have made the first transceiver to be approved," said IT's technical director Mr G. J. Cohen, "because specification RB211d is a tighter specification than those covering land-based SSB."

Designated the Model SB100, the new transceiver is an all solid state unit capable

of delivering up to 100 watts PEP; it can be loaded into almost any aerial from the front panel. With eleven illuminated channels available, several channels can be used for two frequency working into the radio-telephone system.

The frequency range is 1.6MHz to 10MHz, crystal controlled broad band, and the unit can be operated from external oscillators.

A meter is used for power output and also serves as an "S" meter on receive.

Exceptional frequency stability over a long period is guaranteed by the use of an efficient oven and oscillator design.

International Transceivers Pty Ltd, is situated at 535 Pittwater Road, Brookvale, NSW 2100.

## New Mallory battery

Mallory Batteries (Australia) Pty Ltd has recently announced the release of a new nine volt alkaline battery for high current drain applications.

Designated the Duracell MN-1604, the new battery is designed to give maximum heavy drain performance over longer periods and thus is ideally suited for use in pocket calculators as well as transistor radios.

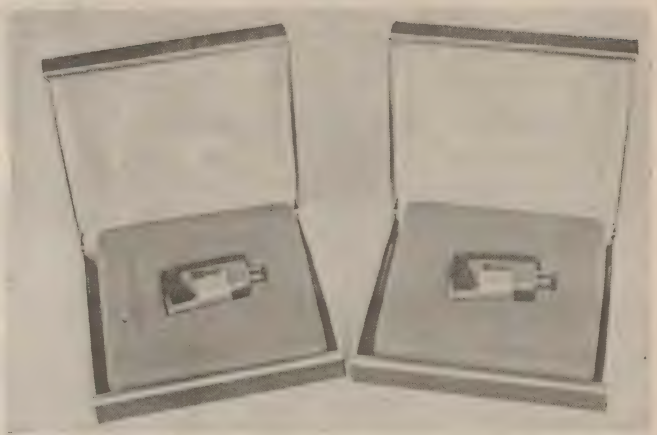
Mallory claim that the new battery will last three times longer in heavy duty use than an ordinary nine volt battery of equivalent size. The company estimates that 45 million nine volt batteries are sold in Australia each year, and hopes to capture a substantial share of this market.

Suggested retail price of the new MN-1604 is $1.50 each.

For further information contact Mallory Batteries (Aust) Pty Ltd, 3 Chilvers Rd, Thornleigh, NSW 2120. Telephone 848 8155.

# Model 600EE stereo cartridge: top of the Stanton range

In the June issue of 'Electronics Australia' we reviewed the Stanton 600E magnetic cartridge. The importers, Leroya Industries Pty Ltd have now given us the opportunity to review the 600EE, the top of the 600 range.



*Identical in appearance and packaging, the Stanton 600E (left) and 600EE (right). Brochure and mounting fitments are under the cushion.*

As we pointed out in the previous review, the 600 series cartridges are a development from the earlier 500 series and closely resemble them both in appearance and construction. The cartridges have been designed with an eye to ruggedness — perhaps a strange word to use in this context — but as a result they have found considerable acceptance in broadcast and other professional situations.

The leaflet which is packaged with the 600EE is the same as for the 600E and quotes the same specifications. In fact, the specifications for all four of the 600 series mentioned are the same, except for the playing weight. The 600E calls for 1½ to 3 grams, the 600A for 2 to 4 grams and the 600AL for a hefty 3 to 7 grams. The user can therefore suit his choice to the anticipated role, from average situations to heavy-handed use or in a primitive record changer. In fact, Stanton even list a stylus for use with 78rpm records. Remember them?

The 600EE is at the other end of the range, with a specified playing weight of 1 to 2 grams and, by implication exhibiting the greatest compliance. The figure of 1 to 2 grams is about average for the current generation of magnetic cartridges — less than some but about double that of the more esoteric designs.

It is fitted normally with an elliptical stylus having minor and major radii of 0.3 and 0.7 mil. The stylus assembly can be withdrawn and replaced easily by gripping the plastic housing between the fingers. No more than ordinary care is required for the operation.

On test, the frequency response proved to be impressive y level, being within plus and minus 1dB from about 28Hz to 12kHz. In the extreme bass register, the response was 1.5dB up at 25Hz and on reference at 20Hz, as much as anything reflecting the interaction of cartridge and arm. At the other extreme, the response showed a modest 2dB rise in the 14 to 16kHz region, with a roll-off to -8dB at 20kHz.

Channel balance was well within the 2dB specification over most of the range, but it did reach 3dB towards the low frequency extreme — a divergence which would not be evident to the listener.

Separation between channels hovered around the 22dB mark over most of the range, peaking to 30dB at 6kHz. This is not as good as the 35dB claimed for the series but it is quite typical of competitive good quality cartridges, under similar test conditions.

Tracking was excellent, the 16dB drum track on the W&G 25 / 2434 test record being handled with no embarrassment. But the main purpose in life for a cartridge is not to play test records but to reproduce music and this the 600EE does with consumate ease, with excellent waveform and transient response.

To aid in fitting the cartridge to a variety of headshells, the Stanton 600EE is packaged with five "Quik-Mount" moulded spacers, designed to mate with such player arms as BSR, Garrard, Dual and "all other" headshells. Electrical connections are effected by the usual push-on clips.

As a matter of interest, we took the opportunity of testing another sample of the 600E cartridge, as featured in our June 1973 review. Frequency response was much the same as the earlier sample, being good but not quite as smooth as the 600EE. However it did trace the 12dB drum groove in the W&G test pressing at the 2½-gram weight recommended by the distributors.

Stanton cartridges are distributed in Australia by Leroya Industries Pty Ltd, 266 Hay St, Subiaco, WA 6008 (W.N.W.).

## Plessey Rola brochure

Plessey Rola have released a new short-form brochure covering more than fifty of their preferred range of loudspeakers. Information supplied includes size, mounting and baffle hole dimensions, impedances available, frequency range, resonance, power handing and gap flux density. The brochure is available from Plessey Rola distributors or from Plessey Rola at The Boulevard, Richmond, Victoria, or Christine Road, Villawood, NSW.

Also available is a new brochure covering the well-known Brenell range of recorders and tape decks, available from Plessey Electronics Pty Ltd, 91 Murphy St, Richmond, or from their interstate agents.

NEW PRODUCTS

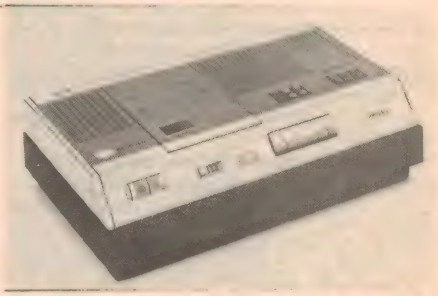
# Low budget VCR from Philips

The Philips Company has announced the release of a new video cassette recorder desgined for the production of low budget video programs.

The new model, known as the N 1520, is basically the same as the N1500 VCR described in the December 1972 issue, but with the added provision of inputs for a video colour camera. It is a fully transistorised unit with facilities for the recording and playback of monochrome and colour programs on cassettes. Also included is an RF modulator for playback via domestic TV receivers. Sound dubbing on two separate sound tracks permits sound to be dubbed onto recorded programs.

Furthermore, the N1520 has facilities for electronic editing as it is provided with "assemble" (the free addition of a new recording, both picture and sound, to an existing recording), and "insert" (the facility to replace certain scenes of an existing program). In the latter case, the original sound track is not erased.

The N1520 also has a special stop motion facility and a stand-by position. The bandwidth of this VCR has been extended to 3.2 MHz for monochrome, and features an improved drop-out compensation. Audio and video levels may be either automatically controlled or manually controlled during recording.



The cassette can be inserted, or taken out of the machine at any position of the tape, without the need to rewind first. Switching foil on the non-coated side of the video tape, at the beginning and end of the tape, provides automatic switch-off. Cassettes are available for 30, 45 and 60 minutes playing time.

The characteristics of the N1520 make it suitable for applications in the non-domestic areas such as education and training, and also in business and commerce. It is a highly efficient medium for the production of low budget video programs on a small scale.

Specifications of the N1520 include: TV system: CCIR, 50Hz, 625 lines, PAL. Dimensions and weight: 560 x 160 x 335mm (w x h x d), 17kgs. Signal to noise ratio (video): 32dB at 75 percent colour saturation (chroma), 40dB according to CCIR specification 421-1 (luminance). Signal-to-noise ratio (audio): greater than 40dB (weighted according to DIN 45405).

For further information contact Philips Industries Ltd, 95-99 York Street, Sydney, NSW 2000. Telephone 2 0223.

## Hewlett-Packard dual directional coupler

Designed for wideband, swept reflection measurements, the new Hewlett-Packard 11692D Dual Directional Coupler covers almost a full frequency decade (2-18GHz).

Hewlett-Packard 11692D (dual) and 11691D (single) directional couplers will be important for broadband applications, particularly for swept measurements, because they feature wide frequency range

(2 to 18 GHz), high directivity (30 dB to 8 GHz, 26 dB to 18GHz), and flat response (+ 1 dB variation full band).

When these couplers are used with a broadband detection and display system, such as the HP8755 Frequency Test Set (o.1 — 18 GHZ), one can make simultaneous swept reflection and transmission measurements on microwave components over a 9 to 1 bandwidth without having to make any changes in the test set-up.

Both couplers can be configured with precision 7mm (APC-7) or Type N connectors.

For further information, contact Hewlett-Packard Australia Pty Ltd, Marcom Department, 22-26 Weir Street, Glen Iris, Victoria, 3146. Phone 20 1371.

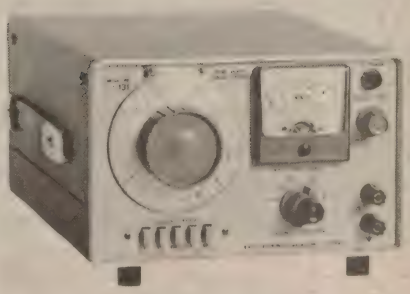
## Communications receiver

A new model "Realistic" DX150B communications receiver is now being distributed by Weston Electronics.

Operating from either 12V DC or 240V AC, the versatile DX150B is fully solid state. It will receive AM, SSB, and CW from 535kHz to 30MHz. The DX150B incorporates a separate external speaker unit, designed as a matched companion to the receiver, for the same price as the previous integrated peaker model.

For further information contact Weston Electronics Pty Ltd, 376 Eastern Valley Way, Roseville.

## *New sine wave oscillator*



BWD Electronics Pty Ltd has added a new precision sine wave oscillator to their extensive range of signal and function generators.

The new model BWD 131-02 provides a constant ouput level over the range 5Hz to 600kHz. Two attenuators and a vernier monitored by a meter enable the output to be accurately set from 2.5V to 1uV RMS.

The output level is unaffected by temperatures from 0 to 50 degrees C, or line voltages from 195 to 265V.

The sine wave output has less than 0.1pc distortion over the range 200Hz to 50kHz, and frequency stability is less than 0.01pc / 10 degrees C.

For further information contact BWD Electronics Pty Ltd, 331-333 Burke Road, Gardiner, Victoria 3146.

## HMV goes quadraphonic

HMV have broken into the four channel market with the release of a new quadraphonic sound system.

Designated series 4-40, the new unit is the first release with an SQ system decoder to be designed and manufactured in Australia. Additional features include the provision of facilities to permit the use of discrete 4 channel tape, and a 2 channel record / play-

back mode. Power output is quoted as 5 watts RMS per channel at 1pc THD.

Enquiries may be directed to EMI (Australia) Ltd, 301 Castlereagh St, Sydney, NSW 2000.

# Variations on an original theme... with Silcron!

**Although it's only two years since the very first Silcron turntable was released, this economical and noise-free belt driven turntable has captured a substantial percentage of the Australian hi-fi market. The original Silcron Mk. III appeals to the hi-fi enthusiast who demands perfection yet is cost-conscious; without doubt it is the finest turntable available at the price.**

**Like all engineers who are also perfectionists, the designers of the original Silcron turntable have recognised the need for a deluxe model. And so we release the new Silcron Mk. IV "Isophonic" Series. It combines all the proven attributes of the Mk. III with new design and engineering features which make it the most outstanding turntable available in Australia today . . . no other turntable offers as much performance for relatively low cost.**

## FEATURES OF THE SILCRON TURNTABLES:—

### SILCRON MK. III.

- Sealed 12 pole synchronous motor.
- Belt drive . . . noise-free.
- Wow and flutter — less than 0.04%.
- Lightning fast speed change.
- Two speeds — 33⅓ and 45 r.p.m.
- Dynamically balanced cast aluminium turntable platter.
- Only 3 moving parts.
- Anti-static mat at no extra cost.
- Height above motor board — 2".
- Precision engineering throughout.

### CHOICE OF MODELS — SILCRON MK. III.

- Basic turntable only, unmounted.
- With motor board and timber base.
- With independently sprung motor board, dustproof perspex cover, professional tone arm and magnetic stereo cartridge.

### SILCRON MK. IV "ISOPHONIC" SERIES.

- New sealed 8 pole 750 r.p.m. synchronous motor.
- Belt drive . . . noise-free.
- Wow and flutter — less than 0.04%.
- Lightning fast speed change.
- Two speeds — 33⅓ and 45 r.p.m.
- Dynamically balanced cast aluminium turntable platter.
- Four times the power of the Mk. III.
- New centre bearing shaft assembly.
- Acoustically insulated turntable platter and pick-up assembly which eliminates acoustic feedback.
- Tone arm tracking is constant.
- New vibration absorbent anti-static mat.

### CHOICE OF MODELS — SILCRON MK. IV

- Basic turntable, unmounted.
- With professional quality tone arm.
- With attractive oiled teak base.
- With professional tone arm and attractive oiled teak base.

Note: Dustproof perspex covers and spring mounted timber bases are available for both Silcron models.

**ASK FOR A DEMONSTRATION!**

See your franchised Bleakley Gray dealer. *You'll find it costs very little to step up to Silcron!*

Service facilities and spares are available in all states, if ever required.

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Perth Office: 27 Oxford St., Leederville, W.A. Tel. 81 4988

INTERSTATE REPRESENTATIVES: N.T.: Pfitzner's Music House, Smith Street, Darwin. Tel. 3801. Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. Tel 2 5322.

# Versatile new hand tool for wire wrap installations

A new low cost hand wire-wrapping tool has been released by the Cambridge Thermionic Corporation. Small enough to slip into a shirt pocket, the new tool is designed for hand wrapping 30 AWG wire on to a 0.025 inch square wrap post. It should be ideal for the speedy assembly of temporary and experimental test circuits. The price is a very attractive $2.00 net.

Conventional wire wrapping, or a modified wrap (where the insulation is wrapped for about one and one half turns), is relatively simple with the Cambion 435-1816 hand tool. The tool will perform a conventional solderless wrapped connection conforming with MIL standard 1130 and EIA standard RS-280 A. Performance of wire wrapped connections made with this tool is excellent, and high strip strengths and tight corners are achieved.

A wrap is made by inserting pre-stripped wire in the end of the tool in either of the offset holes until the insulation comes in contact with the tool. The end of the wire is bent back in a "V" shape to secure the wire in the tool, and the insulated portion is bent at right angles to the axis of the tool. The tool is then placed over the wrap post and lowered to the level where the connection is to be made; it is turned by hand until all the stripped wire has been wound around the post.

A modified wrap can be made by permitting the insulation to turn with the first one and one half turns of the tool.

The tool should be ideal for making field modifications, building small systems in laboratories, teaching, and other non-production wrapping applications.

For further information contact the Australian representatives for Cambion, General Electronic Services Pty Ltd, 99 Alexander St, Crows Nest, NSW 2065. Telephone 439 2488.

# LISTENING TO THE WORLD

by Arthur Cushen, MBE

**The introduction of the new frequency, 9545kHz, by the Solomon Island Broadcasting Service has resulted in better coverage of the ares. It has also enabled reception of the signals in more distant parts of the Pacific.**

The Solomon Islands Broadcasting Service recently introduced the new frequency of 9545kHz, and according to a verification from the station it is providing good coverage in the area. In the past, they have had poor reception from the station in some other islands of the Solomons group during daylight hours. As a result, they commenced transmission on 9545kHz. Although they had trouble in obtaining reception reports from some of the more remote islands, present indications are that at least 70% of the Solomons are able to obtain good reception.

The frequency of 9545kHz is now used from 2130-2400 and 0115-0245GMT daily. Other services are carried on 3995kHz. The station opens at 1855GMT and closes at 1115GMT, and these times give the best reception in Australia and New Zealand.

### HJDJ ON 3135kHz

An unusual signal has been heard in New Zealand in the past few weeks on 3135kHz when HJDJ has been closing its transmission at 0500GMT, and heard again opening at 1100GMT. This frequency is outside the usual 90 metre band and according to the station announcement, they are operating only on medium-wave on 1030kHz. HJDJ has the slogan "La Voz de los Libertadores" and is located in Duitama, with the mailing address of Aereo 1030, Duitama, Colombia. This station has also been received by Chris Davis of Featherston, NZ, who confirms our reception, hearing the same type of program, at good strength.

### RECENT VERIFICATIONS

PAPUA NEW GUINEA: Radio Kundiawa confirmed reception with the usual folding sheet which indicates stations operated by the Administration. Radio Kundiawa operates on 2370kHz with 2kW, 0630-1200GMT. Broadcasts are in Pidgin Kuman, and the mailing address is PO Box 228, Kundiawa, Chimba District Papua New Guinea.

MARSHALL ISLANDS: WSZO which operates on medium-wave 1440kHz and can be heard up to 1200GMT; verified with a prepared card signed by L. N. Edwards, Station Manager. The address of the station is Radio Station WSZO, PO Box 18, Majuro, Marshall Islands, 96960.

### AFRICAN NEWS

Some of the latest news from the African continent is supplied by Colin Miller of Johannesburg, who reports, that after many months of negotiations, Trans World Radio have at last got the green light to build a radio station in Swaziland. The only information available is that there will be one high powered medium-wave transmitter and several short-wave transmitters, and the target area will be Africa, south of the equator.

FEBA Seychelles has been heard on 15133kHz at 1235GMT sign-on. This is probably a test from their new 100kw transmitter.

### BRAZILIAN CHANGES

Some major changes have taken place in Brazil with the establishment of new stations and the resiting of others according to Marten van Delft of Holland, who recently visited Brazil.

The station to be given a new location is Radio Rural Brasileira, which is being moved to the town of Altamira, Northern Brazil, by the new Transamazonic Road. It will be renamed Radio Novo Mundo. A decree to this effect was enacted by the Government of Brazil.

Radio Nacional, Rio de Janeiro, is currently using a new 100kW transmitter on medium-wave, 980kHz. The old 50kW transmitter which was formerly on 980kHz is being converted for short-wave operation and will use a frequency of 6145kHz.

Radio Aparacida, which operates on 9635kHz from 0900-0300GMT and uses 10kW, is building a new short-wave complex, which will be in operation by the end of the year.

### COLOMBIAN NEWS

Another transmitter operating from Bogota has been heard on a 24 hour a day schedule in the 49 metre band. For some months Radio Super on 6065, Radio El Sol on 6143 and Radio Emisora Nueva Granada on 6160kHz have been operating all night, and are best heard around 0700GMT.

Another Colombian station is also operating throughout the night on an irregular basis and this is Radio Continental on 6125kHz. The station has the call sign of HJKE and the postal address is Aereo 8467, Bogota, Colombia. The station has been received well on 6125kHz up to 0800GMT when the frequency is blocked by the Voice of America at Delano, which opens at 0800GMT on the same frequency.

### BANGLADESH SCHEDULE

According to the Radio DX Club of India another transmitter of Soviet construction, 100kW power, is now in use. The external service schedule of Radio Bangladesh, is as follows:

| GMT | kHz | Language |
|---|---|---|
| 0230-0300 | 9690, 15520 | English |
| 1230-1300 | 15455, 17690 | English |
| 1320-1400 | 4890, 9850 | Nepali |
| 1410-1800 | 11650, 15520 | Various |
| 1845-2100 | 9495 | Bengali |

### SOUTH AFRICA CHANGES

In the past few months, Radio South Africa at Johannesburg has made several attempts broadcasting to Australia and New Zealand on a regular basis, but without success. The transmission times have not been altered, but lower frequencies have been used in an attempt to provide a reliable signal in this area.

The new frequencies for the transmission to New Zealand from 0755-0850GMT are 9525, 11970, and 15220kHz, these channels replace 15160, 15220, and 17805kHz. The service to Australia from 0855-0950GMT has been assigned the same new frequencies. The falling sun spot count has resulted in the need for lower frequencies, furthermore, the path from South Africa across the Auroral Zone makes transmission difficult. According to Radio South Africa in their June report, they state that in the service to Australia and New Zealand, all frequencies are unsatisfactory. The possibility of changing the beam direction and/or time of broadcast is being investigated to provide better reception.

### CBC SOUTH PACIFIC SERVICE

The Canadian Broadcasting Corporation has a daily service to the South Pacific, which is well known to listeners in this area. Recently the writer broadcast on the Radio Canada Short-Wave Club a history of his association with the CBC International Service.

The 50kW transmitters at Sackville were first heard in 1945, and during that year, many reception reports were furnished at the request of Jack Acton; sent from the BBC London to get the service in operation. My appointment of Technical Observer followed shortly. On July 6, 1947, the first transmission to the South Pacific was broadcast, and the cablegram received announcing this new service, indicated it was to be broadcast on Sunday only, from 0800-0900GMT on 9610 and 11720kHz.

Following the success of this weekly broadcast, a daily transmission was commenced and the time changed to 0830-0930GMT, which is the schedule at present. The frequencies were altered to 5970 and 9630kHz, which carried the transmission for many years, but in November 1971, the frequency of 9625kHz replaced 9630kHz, and these two frequencies are in use today. A power increase from 50kW to 250kW was made in the past year, and Radio Canada is now one of the most consistent signals in Australia and New Zealand.

### MASIRAH ON 1320kHz

The BBC relay station on Masirah Island in the Red Sea has recently changed frequency. The station which was opened in 1969 consists of two 750kW transmitters, and in the past has operated on 701 and 1410kHz. The 701kHz transmitter carries the Arabic service, as well as other languages of the Middle East.

The transmitter on 1410kHz carries the BBC World Service and recently moved to 1412kHz to avoid interference, but as this move was not successful, the new channel of 1320kHz is now being used. Reception in this area is best around dawn when BBC News at 1800GMT can be heard under the signals of 3BA Ballarat.

There is some controversy in DX circles as to whether Masirah is counted as a new country, as it is generally listed as part of the Muscat Protectorate. The status of several of the former States in this area of the Persian Gulf is under discussion at the moment, since they are no longer under British protection. In the case of Masirah, it is known that this Island was bought by Britain to provide the site for a relay base in the area. In the past, the BBC has established relay bases in Somalia, closed down when the country gained independence, and likewise when Aden and Perim received their independence, these transmitters were also closed. It is generally agreed that Masirah is a new country for the medium-wave listener.

### POPULARITY POLL

Recently, a survey was conducted by one of the leading North American short-wave clubs, to find the most popular station with listeners in that part of the world. Last week the results were announced, and Radio Nederland at Hilversum, Holland, was placed first. This position has been held by the station for many years in various polls conducted throughout the world, which is proof of its high esteem with listeners. Second place went to the BBC World Service, followed by Radio Canada, the Voice of America and Radio Australia took fifth place.

These five stations continue to dominate International Short-wave listening. Stations like Radio Moscow, Radio Peking and others, which operate for longer hours and with more powerful transmitters, have failed to gain any recognition in recent surveys.

### FLASHES FROM EVERYWHERE

MALTA: According to a report in Frendx, the Deutsche Welle has advised, that the station's new relay base of three 250kW short-wave transmitters will become operational in 1974. It is only 20 years since Deutsche Welle commenced operation from its transmitters in Germany, when a 20kW station was opened on 3 May 1953. Since then, the station has made rapid progress, with an increase in power to 500kW of several of its transmitters, while a relay base at Kigali in Central Africa is also operating. Plans have also been announced for another relay base, to be built in the Caribbean area jointly with the BBC.

SWEDEN: Radio Sweden is issuing a new verification card to celebrate the 25th anniversary of Sweden Calling DXers. This new card commemorates the first broadcast in February 1948, and the card details how this is one of the world's oldest and best established programs for DXing.

ANDORRA: According to, "Sweden Calling DXers," Radio Andorra has returned to short-wave, and is being reported on 5955kHz. This is a relay of the medium-wave program, which is on the air from 0500-2400GMT. Radio Andorra, has been on short-wave previously, and we first verified this country in 1945 when they were using 5985kHz.

MONACO: Trans World Radio has an added Russian transmission at 0345GMT on the new frequency of 7125kHz.

INTERNATIONAL WATERS: "Radio Atlantis" is a new commercial radio pirate station, which took the air from an anchorage in the North Sea. It was fitted out in Denmark, and it is broadcasting commercial programs to listeners in Belgium. The ship is supported from the Netherlands.

### ASIA

SOUTH KOREA: HLDA on 1570kHz, operated by the Far East Broadcasting Company, is now in regular operation and can be heard at 1500GMT. The power of the transmitter is 250kW, and the station was recently moved from Okinawa to its new site on Cheju Island. The station carries gospel programs in Korean and Chinese.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street Invercargill, New Zealand. All times are GMT. Add 8 hours for WEST, 10 hours for EAST, and 12 hours for NZ, plus 1 hour if on daylight times.

# AMATEUR BAND NEWS & NOTES

by Pierce Healy, VK2APQ

## An amateur "first" — Doppler anomaly

It is rare these days for amateur radio to bring to light something new about accepted scientific theory. Observations made of the OSCAR 6 beacon may add to the knowledge of Doppler effect and UHF propagation.

The editorial in the June 1973 "AMSAT Newsletter" the Radio Amateur Satellite Corporation publication, carried a message that emphasises a contribution that amateur radio could make to the world of science. The editorial by Tom Mitchell, WB3TBD, and the subject he refers to indicates that the amateur satellite project could be the means of amending current scientific theory.

". . . . 'Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art . . . . .'

"These words, which should be familiar, are one of the major fundamental purposes of the Amateur Radio Service as set forth by the FCC. They are words we can be proud of . . . especially if enough of us continue in this tradition.

"In this issue we have some information of investigation and research into a phenomenon which, if its existance is proven, will no doubt be considered a major contribution to knowledge in the physical sciences. (See article on 'Inverse Doppler' elsewhere in this issue.)

"Those of us who, for one reason or another, are unable to assist in this type of investigation should highly commend those who can and do. Taking the time to make the meticulous observations and calculations needed to document a phenomenon of this type takes real dedication.

"Whether or not these efforts, or similar ones, result in significant contributions to knowledge, everyone who supports AMSAT can feel that they are supporting one of the most worthwhile of amateur radio's scientific quests in pursuit of the above mentioned 'fundamental purpose'."

Space will not permit the inclusion of the article on "Inverse Doppler" in full, but some of the major points are given which may be of interest and tempt some to observe the phenomenon. Colleges and universitys, or establishments with specialised equipment to make accurate measurements, could possibly make observation for comparison with the findings in the United States.

The article on "Inverse Doppler" is by Ron Dunbar, W0MJS and John Fox, W0LER, and records their observations while tracking OSCAR 6 and subsequently other scientific and navigational satellites.

". . . . a UHF propagation anomaly was first discovered while observing the 435.1MHz telemetry beacon aboard OSCAR 6. For the lack of a more descriptive term, we have chosen to christen the anomaly 'Inverted Doppler'.

"The Doppler effect theory may be stated in a simplified form as follows:— As the satellite approaches the observer, its velocity is added to the velocity of propagation of the radio signal, creating an upward frequency shift of the order of 8KHz above the true (transmitted) frequency at 435MHz.

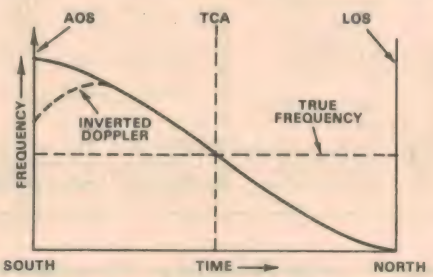
"The amount of upward shift gradually but steadily decreases until the instant when the satellite is nearest the observer, or 'TCA' (Time of Closest Approach). Its velocity relative to the observer is then zero, and at that instant the observed frequency is the same as that transmitted from the satellite; ie, no frequency shift either up or down.

"As the satellite recedes from the observer, its velocity is subtracted from the velocity of propagation, resulting in a total apparent downward frequency shift of approximately 8KHz; a shift during one orbital pass of plus or minus 8KHz, or 16KHz total.

"This normal effect had been noted on all previous OSCAR satellites. However, on 24th October, 1972, W0LER (John Fox, of Minneapolis) noted an unusual occurrence immediately following 'AOS' (acquisition of signal) on Orbit 118 of OSCAR 6. Instead of the normal frequency shift, the frequency was climbing at a rapid rate. The climbing effect gradually decreased, stopped, and then followed the normal Doppler shift for the duration of the pass.

"Since no one else in the Minneapolis area was tracking the 435MHz beacon at the time, W0LER was unable to verify the observations and assumed the strange behaviour to be caused by drift in his receiving system. A thorough equipment check revealed no malfunctioning components. Subsequent orbits occurring that evening exhibited only normal Doppler characteristics.

"The following evening, the same upward shift was noted! This time, both the amount of upward shift, as well as the duration of the effect were measured and recorded as being approximately plus 450Hz and seven minutes following AOS.




*Solid curve represent Doppler theory. Dotted portion shows effect observed during north bound night time passes.*

"At this juncture, W0LER contacted W0MJS (Ron Dunbar, also of Minneapolis) who had been observing signals on the 146 / 29MHz translater aboard OSCAR 6. After discussing the anomaly at length, W0MJS modified his receiving equipment to allow reception of the 435MHz beacon.

"With two tracking stations now in operation, the rate of data collection was greatly increased, and with the stations on a north-south line only 40 kilometres apart, it was readily verified that both stations observed exactly the same phenomenon.

"After about three weeks of tracking and data analysis, it became evident that the Inverted Doppler anomaly was roughly confined to an equatorial crossing between 60 degrees west and 90 degrees west. It was not possible to closely define the exact boundaries at the time.

"Further analysis revealed that the duration of the effect was related to equatorial crossing time and showed an average duration of approximately 7.5 minutes past equatorial crossing on the northbound night time passes of OSCAR 6."

W0LER and W0MJS then turned their attention to southbound orbits passing the same area in which the effect had been noted on the northbound passes.

"Extensive investigation proved fruitless. Absolutely no abnormal effect was observed on southbound daytime passes, even though they crossed exactly the same area as the night time passes had."

Continued investigation of the night time passes resulted in further refinement of the data. The effect was found to encompass an area between 50 degrees west and 105 degrees west longitude as observed from the location in Minneapolis 45 degrees north, 105 degrees west. The magnitude of the upward shift varied from 20Hz to 550Hz, with the greatest majority of measurements falling in the range 200-500Hz. Duration of the effect past equatorial crossing averaged 7.43 minutes, with 91pc of the readings falling within the range 6-9 minutes.

Checks were made on the 137.5MHz signal from the NOAA-2 weather satellite launched from the same vehicle as OSCAR 6. Even though these two satellites were only 20 minutes apart with almost identical equatorial crossing, no inverted Doppler effect was noted on the NOAA-2 satellite 137.5MHz signal.

When the 435MHz beacon's power output dropped on orbit 1081 the two observers built equipment for the 400MHz satellite band, with these results:—

"Finally . . . we experienced success on January 30th 1973. Inverted Doppler was observed on a satellite named Copernicus, operating on approximately 400.562MHz. Spurred on by this new evidence, and assisted by many other amateurs who suggested possible frequencies, satellites, and orbital parameters, we finally located a group of five satellites which were in continuous operation and in a near circular orbit inclined only plus or minus 2 degrees off the poles.

"These satellites are part of the Navy's 'NAVSAT' (Navigational Satellite) system, transmitting on 149.998MHz and 399.968MHz simultaneously, by multiplying a common frequency source at 49.996MHz 3 and 8 times. One important difference between these satellites and OSCAR 6 is their orbits' relation to solar time. At the tine we commecned tracking the NavSats, their northbound pass occurred in the daytine; southbound at night; exactly opposite of OSCAR 6.

"The 'Inverted Doppler' was indeed observed on the southbound night time passes, occurring almost exactly as predicted earlier. The normal downward shift merely tapers off and ceases, followed by several minutes of absolutely stable, steady signal until LOS. Absolutely no abnormal behaviour was observed on northbound daytime passes.

"Finally, all the necessary data were collected and a new set of computer listings containing orbital predictions was rapidly prepared by W0RLI (Hank Oredson). As the fates would have it, the effect ceased abruptly on the next day 5th February 1973. As of 5th May, 1973, the effect has not been observed again."

"To summarise some of the findings concerning the anomaly:—

"1. Inverted Doppler is apparently a night time effect.

"2. Inverted Doppler is apparently a seasonal effect, perhaps centred on the winter solstice.

"3. Inverted Doppler seems to be frequency selective, since its effect was never observed at 137.5MHz.

"4. Inverted Doppler effect apparently ceases when the satellite reaches the vicinity of 23.24 degrees north latitude (average) computed from the satellite's velocity and average duration of the effect. (The tropic of cancer is located at 23.5 degrees north latitude.)"

Investigation into the phenomenon continues, using data gathered by research satellites, but no conclusions have been reached. W0LER and W0MJS would welcome any assistance in the effort.

Looking at a world globe it would appear that the southern portion of the South Island of New Zealand is geographically located for observation to be made from a corresponding latitude in the southern hemisphere. Southern Tasmania could be another possibility.

There is no doubt that reports on observations from those areas as well as from others, would be welcome.

Remember, observations which reveal no variations in the normal Doppler Effect are just as important to researchers. However, all should be accurately documented.

### OSCAR 6 NEWS

OSCAR 6 surely must be the most versatile, truly international, simplest communication satellite yet placed in orbit. It was produced on the lowest of budgets (in the main, voluntary work and donation of components), but with a large number of participants in the fields of design, construction, evaluation liaison, observers and operators.

By providing free access to all it has, in fact, proved that every backyard could be a satellite communication site. Maybe that comment is not as far-fetched today as the "Dick Tracy wristwatch radio" was in the comic strips, a few years ago.

At the time of writing, OSCAR 6 had been in orbit for nine months. Through the modifications to the operating schedules, to subject the nickel cadmium battery to shorter, more frequent charge-discharge cycles, it is thought that the useful lifetime of the satellite may be extended beyond the planned period of one year.

More than 1100 stations have made one or more contacts via OSCAR 6, very nearly half of them being outside the United States of America. The contacts

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, 2200.

include stations from 59 countries, including: CT2, DL, DU, EA, EI, F, FC, FP8, G, GI, GM, GW, HA, HB, HG, HK, I, JA, KP4, KX6, LA, LX, LU, LZ, OE, OH, OH0, OK, ON, OX, OZ, PA, PY, SM, SP, SV, TF, UA1, UB5, UC2, UG6, UJ8, UR2, UW6, VE, VH, VK0, VP2V, BP9 VU, W, LX, YU, ZE, ZL, ZS, 4X, 6Y, 8P.

The operator leading with the most reported contacts via OSCAR 6 is K7BBO with over 3300 QSO's and is averaging about 500 satellite contacts a month.

The first reported aeronautical mobile communication via OSCAR 6 was by W60AL, who reported working K7BBO on 27th April 1973, over a distance of approximately 8047 km. The transmitter aboard the aircraft was a Gonset Sidewinder operating on SSB with less than 5 watts PEP to a simple whip antenna. W2GN has had many successful contacts via OSCAR 6 using an automobile OSCAR terminal.

AMSAT is encouraging more mobile terminal operation with OSCAR 6. In particular, operation from small private aircraft, small boats and automobiles, especially on SSB, would provide a very effective demonstration of the usefulness of amateur satellites for small terminal communication.

A suggestion by Perry Klein, K3JTE, president of AMSAT, opens up a new field for experiments which if successful would outshine the achievements of the comic strip character referred to eariler. It is not suggested that the impossible is being presented as logical experiment, but one within the realms of possibility.

"..... operation using totally hand held equipment or operation from a bicycle or motorcycle would be impressive 'firsts', and we urge anyone interested to give it a try. If possible make tape recordings of some of the mobile contacts and send them to AMSAT.

## QUARTER CENTURY WIRELESS ASSOC.

Membership of the Sydney Chapter continues to grow. Inquiries have been received from other VK2 call areas.

Membership applicants must have held an amateur licence at least 25 years ago and at the time of application hold a current licence. Dues, payable in advance are $7.00 for three years, $14.00 for 6 years and $35.00 for life membership. Each applicant must pay an entry fee of $3.00.

QCWA members receive a chronological numbered certificate of membership, dues and identification card, the QCWA call book (every two years), a supply of QCWA stamps, QCWA decam and the QCWA news issued quarterly.

The QCWA is primarily a social organisation and provides a means of keeping in touch with old friends at chapter luncheons, dinners and social outings. Membership is in excess of 8500 spread in many countries. Headquarters are in New York, USA.

The Sydney Chapter has the honour of being the first and only chapter formed outside the USA.

The Sydney Chapter meets for dinner at 7.00 pm on the second Wednesday of each month at the RSL Memorial Club, North Sydney. After dinner those present adjourn for discussion on topics of common interest, informal type address by overseas visitor or invited guest, or to hear highlights of an overseas trip by one of the group, these often being illustrated by colour slides.

Officers are:

Harry Caldacott President VK2DA

Registrations from 10.00 am at Showground. Mobile "Channel B" scramble on the way to Showground, one contact per station, all stations within 160 kilometres of Illabo. Hidden transmitter hunt in the afternoon. Morning and afternoon teas will be provided. Smorgasbord dinner will be served at 7.30 pm, preceded by drinks. The local Red Cross and CWA have combined their culinary talents, so the evening meal will be good. The evening entertainment will include competitions for the children and a possibility of a demonstration of colour television.

Sunday, 30th September, 1973.

10.00 am to 11.00 am — All band scramble.

11.15 am to 12.30 pm — TAlk-in Fox hunt.

12.30 pm to 2.00 pm — Barbecue lunch.

Afternoon events will include:—

Hidden transmitter hunts, blindfold hunts, ladies 144MHz scramble, transmitter throwing contest, making an abstract sculpture from old radio parts. Also raffles and quizzes. It is also hoped to have commercial displays, kit sets and text books for sale.

There will be a contest for the most unusual piece of amateur gear — can be anything!

Good prizes will be presented to the lucky contestants and the "Area 5 Contest Award" will be presented on Saturday evening after the dinner.

Monday, 1st October 1973.

Drive around the district and some of the best farm land in Australia before returning home.

The South West Zone convention is one which you really cannot afford to miss. Make arrangements now to take the family away from home for an enjoyable weekend at Illabo.

### Central Coast Amateur Radio Club

With the Gosford Show only a week or so away, members are busy organising the club station, VK2AFY, for portable operation at that event. The Show will be held on 22nd and 23rd September, 1973, and the Show Society have invited the club to stage an exhibit. Demonstrations will be given on both HF and VHF bands.

The Central Coast Field Day has been set down for Sunday, 24th February, 1974, at the Gosford Showground. Make a note of the date.

A slight modification has been made to the tune up circuit of the Central Coast repeater, VK2RAG. To trigger the slow speed call sign transmission, a tone of 180Hz is required in lieu of the original 190Hz. The modification became necessary because transmissions

from some stations with 50Hz hum harmonics can trigger the slow speed call sign circuit.

The president Dick Maitland, VK2BBK, will welcome visitors to the club rooms at Dandaloo Street, Kariong. Correspondence should be addressed to the Secretary, Barry Gibbens, VK2ZUX, PO Box 238, Gosford 2250, NSW.

### St George Amateur Radio Society

Meetings of the St George Amateur Radio Society are held on the first Wednesday of each month at 7.30 pm, in the Civil Defence Headquarters rooms, The Mall, South Hurstville. The location is 90 metres off Ring Road 3. Visitors are welcome.

In addition to lectures and discussions on various topics at the monthly meetings, visits are made to technical and non-technical institutions. AOCP classes are conducted for those wishing to gain their amateur licence. The club's newsletter "Dragnet" is published monthly.

Membership fees: Full $3.00; Associate $2.50 per year, due on the first Wednesday in May.

Telephone enquiries may be directed to the president, John Lambert on 546 6873.

All correspondence should be addressed to PO Box 77, Penshurst, 2222 NSW.

The societys call sign is VK2LE and members are on the air every Tuesday, 8.00 pm.

### Sydney University Amateur Radio Club

The inaugural meeting of the Sydney University Amateur Radio Club was held on Wednesday, 4th July, 1973. After much discussion the constitution was formulated and office bearers elected. These were:

| | | |
|---|---|---|
| President | Chris Middleton-Williams | |
| Vice-president | Bruce Paterson | VK2ZK1 |
| Secretary-Treasurer | Jeff Pages | VK3BYY |

The subscription fees were set at $2.00 per year for full membership and $1.00 for associate. Associate membership being available to those other than students, graduates and staff of the university.

Application will be made to the PMG's Department for a club station licence and call sign. Negotiations were being made for a room in which to set up the station.

The club meets most Wednesdays at 1.00 pm in Carslaw Tutorial Room 8. Anyone interested is invited to attend.

Proposed club activities include Morse code classes, commencing in the third term and a range of club projects.

Inquiries should be directed to:
Sydney University Amateur Radio Club, Box 398 Wentworth Building, Sydney University, 2006 NSW.

### West Australian VHF Group

Several more pieces of equipment have been donated to the West Australian VHF group for the Wireless Hill Museum. These included an AM transmitter, an emergency calling system, and an old transceiver. It is understood that these were once used in the Royal Flying Doctor Service.

The Wireless Hill Museum project is being undertaken by group members in conjunction with the local council authorities.

Meetings are held on the fourth Monday of each month at Wireless Hill. Visitors are welcome.

"Olympic Way" between Junee (13 kilometres) and Cootamundra (38 kilometres). The convention will be held at the Illabo Showground.

The convention organiser, Jim Pratt, VK2ZPP advises that accommodation will be available at a small motel at Illabo. However, there are three motels at Junee and many hotels. Caravan sites are available at the Illabo Showground with power and new toilets (without showers). Junee has a good camping ground with all facilities. Accommodation may be booked by club's sending a deposit of $2.00 to J. Pratt, "Inglestate. Illabo, 2591, NSW. Bradley,

Program: Saturday, 29th September, PO Box

AE
minence in
ructors and

the need to practice safety first and the YRCS rules regarding mains operated equipment.

The YRCS will not accept any mains operated equipment as projects until the member has the Junior Radio certificate. They do not allow any junior grade member to work on or construct mains operated equipment while at the club or class unless they have written permission from their parents. Adult members attending classes are the only exception.

So far YRCS clubs have a clean safety record, and it is the policy of the organisers to keep it that way, and make YRCS a safety conscious organisation throughout.

Broadcasts to YRCS members and clubs are on the first Saturday of the month, at 3.00 pm EST, on 7146KHz. The broadcast is originated by the NSW state supervisor, Kev Watson, using the call VK2BHV. News for this broadcast is requested from all club leaders. Send it to — the State Supervisor, Box 54, PO East Maitland, NSW 2323.

The official YRCS publication is "ZERO-BEAT" edited by A. W. Grove of Salisbury, South Australia. The magazine contains articles of interest to YRCS members and short-wave listeners. Included is news from clubs, correspondence, news, technical articles and descriptive articles on projects suitable for the various certificates.

The subscription for "ZERO-BEAT" is 60 cents per year post paid in advance. The publication is issued every two months, starting with February.

Correspondence should be addressed to: The Editor, Zero-Beat Publications, 6 Trueman Avenue, Salisbury East, S. Aust 5109.

### Correspondence Section

From time to time names of ex-correspondence section members appear in the list of successful AOCP or AOLCP candidates. In order to evaluate the course, the secretary of the correspondence section, Bill Tremewen, would like to hear of their success.

Correspondence section students who were successful in recent YRCS examinations were:

Elementary certificate: John Biddell, Alan Kalir, Rowan Gosper, Christopher Trevitt.

Junior certificate: John McKirdy, Bruce Kreutzberger, Scott Anglim, Evan Stanbury, David Phillips, Wayne Brack, Patrick Dibben, Ted Garnett.

Intermediate certificate: Paul Compton.

The last five named were students of Group Leader Gordon Proctor who conducts YRCS activities in the Gosford and Central Coast area of NSW. Gordon's address is 24 York Street, East Gosford 2250.

For details of the correspondence section in all states write to: The Secretary, YRCS Correspondence Section, W. Tremewen, 34 Flower Street, Ferntree Gully, Victoria 3156.

### St George YRCS Training Annex

Anticipating the novice licence, changes have been made to the Audio/Visual instruction system used at the St George YRCS Training Annex.

In reviewing the results of the Annex activities, the education officer said thirty-one YRCS certificates had been obtained by students. These constituted a pool of candidates ready for the novice licence as soon as it is introduced.

The revised syllabus will provide lectures on Elementary Radio Theory and PMG Regulations. The Morse code trainer will be programmed to teach candidates to read the code at three words per minute in six weeks, then progressing to the 5WPM novice licence standard.

The new class will commence at an early date. To avoid disappointment, intending students are invited to enrol now. Applications to — Noel Ericsson, VK2MF, 17 McIntyre Avenue, Brighton le Sands 2216, or telephone 59 1658 for further details.

### Westlakes Radio Club

The Westlakes Radio Club will shortly be moving to a new location. As the result of negotiations by the club committee a suitable site has been leased by the Lake Macquarie Shire Council in York Street, Teralba. The club has secured a building suitable to be moved to the site and a board of five trustees has arranged finance. The club will at last have its own premises.

The new location is close to rail transport and has plenty of parking space. Working bees will be a major activity in the coming months to install the various facilities for the YRCS classes and social activities.

Those wishing to participate in YRCS instruction classes in the Newcastle and Lake Macquarie areas should contact the secretary Eric Brockbank, VK2ZOP, PO Box 1, Teralba, 2284. The YRC director is Joe Waugh, VK2IQ, telephone 68 2642 (Newcastle).

### Maitland Radio Club

The Maitland Radio Club has won the Institution of Radio and Electronics Engineers, pennant award for the fourth time since the club was formed seven years ago. Pennants are made available annually by the IREE through the WIA YRCS to the most efficient school and non-school radio clubs affiliated with the scheme in NSW.

The award for the school club went to the Marist Brothers High School Radio Club, Parramatta. The club leader, Rev Bro Gyril, gained his own amateur licence through the YRCS classes at the Maitland Club.

During 1972 the MRC achieved outstanding success with 72 YRCS certificates gained by club members. Three of the four Advanced Radio Certificates issued in NSW have gone to members of the MRC. The Advanced Radio Certificate is the highest award available in the YRCS.

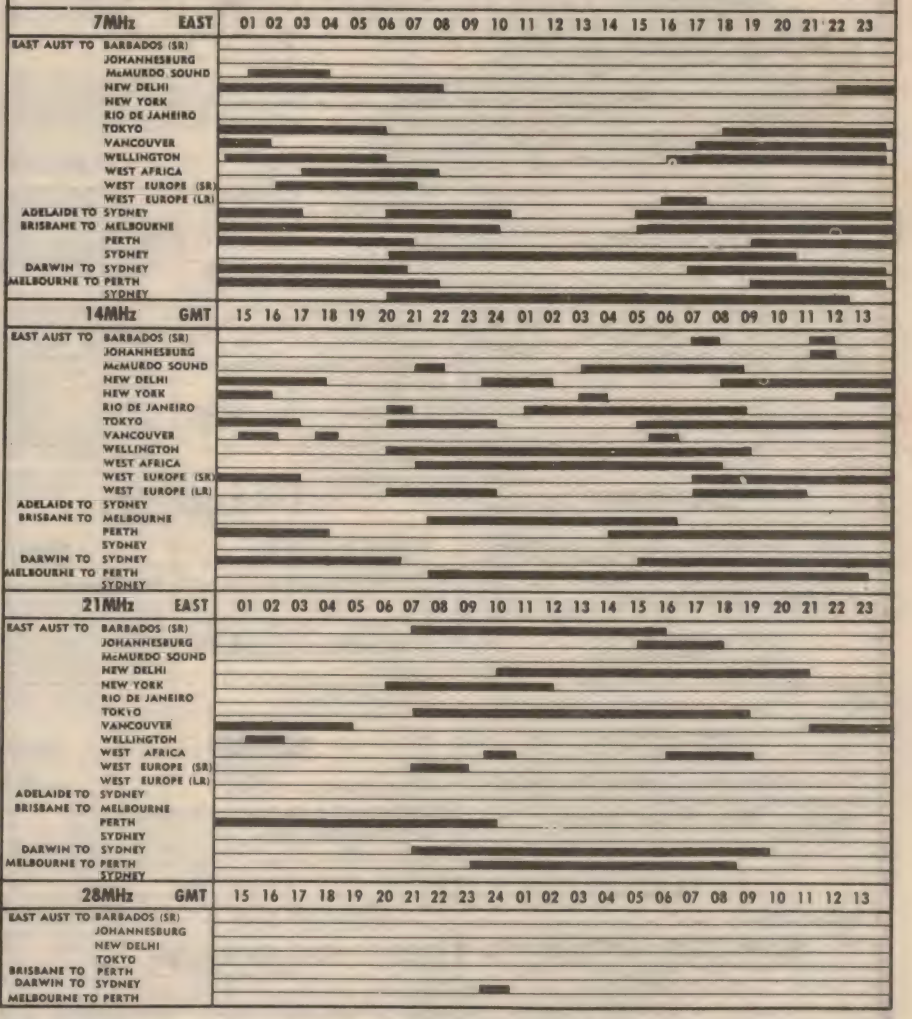
The club has finalised plans for the construction of a static display unit. The unit which will be portable will have facilities to show facets of the club's activities to the general public. It will include a scale model of the club, photographs and an electronically controlled sound recording of the club's progress.

The NSW power restrictions did not hamper classes at the MRC. Emergency power equipment installed a few months ago was put to the test and proved its value. The system, designed and installed by members, operates automatically. It will allow the club station to be fully operative in the case of floods or other emergencies.

Interested persons visiting the Maitland area are invited to visit the club. For details, telephone Maitland 372282 or 337286. Postal address is Secretary, Box 54 PO, East Maitland.

## IONOSPHERIC PREDICTIONS FOR SEPTEMBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). They have been prepared for the four most popular amateur bands over a number of interstate and international circuits. Black bands indicate periods when circuit is open. 9.73



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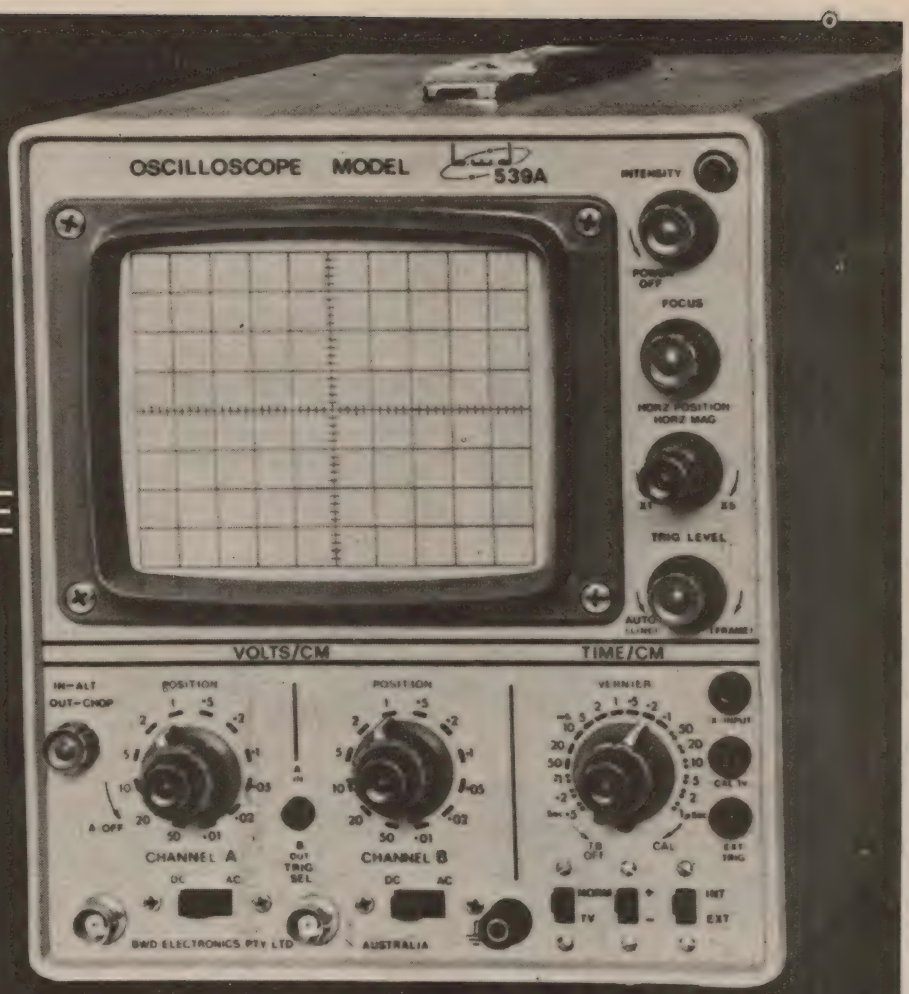


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# INFORMATION CENTRE

**DIGITAL CLOCK ALARM:** Having just read the article "Low Cost Digital Clock" in your June issue I was wondering if it is possible to use the remaining three-quarters of the second 7400 IC in the time-setting circuitry as the logic section for an alarm. By connecting four of the six floating inputs to the appropriate pin on each of the four indicator tubes using thumbwheel switches, the NAND gates could be wired to give an output at the selected time. Could you please tell if the idea is possible and also what type of alarm may be used.

Also, is it possible to wire a press-to-break switch in the 50Hz line from the 330 ohm resistor to "hold" the display to aid in time-setting when overshoot has occurred? Thank you for keeping us up to date on the novice licensing scheme and hope you will continue. Finally thank you for a fine magazine. Keep up the good work. (T.S., Reservoir, Vic.)

Your basic idea for an alarm is good, but unfortunately 7400 NAND gates will not interface with the high voltage outputs of the 7441 decoders. You would need separate low voltage output decoders such as the 7442, or more complex BCD switching. Also your method of connecting the NAND gates together is incorrect. There is no reason why you cannot incorporate a switch to break the input signal to the clock to hold the display, however; this seems a good idea. Thank you for your encouraging comments.

**ELECTRONIC ENGINEERS IN TRAINING:** I enjoy reading your magazine very much and want to become an electronics engineer. Can you please advise me what subjects to concentrate on at school and what subjects are offering at universities as I cannot obtain any definite information on this subject. Are there any drawbacks for a diabetic in connection with electronic engineering? (M.S., Hamilton, Victoria.)

First of all M.S., don't give the matter of being a diabetic another thought; this will have virtually no bearing on your activity in the field of electronics unless perhaps you are aspiring to the role of a spaceman!

Concerning the matter of training; you do not say what year you are in at school, at the moment, so it is a bit hard to advise exactly. Assuming you are in third year, it would be wise to concentrate on maths, science, and English for a start. When you have completed your schooling it will be more appropriate to think in detail, as tertiary courses are in a state of change, and are constantly being modified to cope with the rapid strides in the technology.

There are many aspects you may care to concentrate on such as communications, circuit design, radar, computers, television, and so on. Although the beginning is the same, courses diverge at a later stage to cope with the specialised knowledge required.

**CARAVAN STEREO:** As a keen caravanner, I have need for a unit combining a 3W per channel stereo amplifier to accept the input from a cassette recorder or playback deck, with a tuner capable of both long range and broadband performance, all to operate from 12V DC or the 240V mains. I feel there would be a demand for such a project. (Signature undecipherable, Canterbury, NSW.)

Most of your requirements would be met by commercial radio / cassette players sold for car installation, and we are inclined to doubt whether a home constructed project along these lines would be economically viable, particularly in view of the competitive pricing of some of these units and the present parts position. However, we will keep the idea in mind.

**VINTAGE RADIO RECEIVER:** I recently acquired an old radio receiver made by Crammond. It covers the BC band and a SW band, 13-44 metres (17-22MHz) and contains such valves as 80,6CL6G an EK2G and two others covered with shields. The speaker is an 8in Rola, electrodynamic type with a 1200 ohm field coil and a 4k ohm impedance transformer. Could you or any ot the readers supply me with a circuit diagram, parts list or any information including the date of manufacture? (Mr W. Syratt, 179 Osborne Rd, Mitchelton, Queensland 4053.)

Perhaps some reader can supply a circuit and details, but our guess would be that it would be a dual wave four / five valve receiver of about 1937 vintage. We suggest the valve line up would be something like this; EK2G octode converter, followed by an IF amplifier such as an EF97 followed by a duo-diode-tridod such as an EBC33 and the 6CL6G as an output valve. The 80 is a full wave rectifier and the HT would be about 250V. The IF would be something like 455kHz and the circuit would be fairly standard for that type of receiver.

**LIGHTHOUSE TUBE:** I have recently acquired a CV90, a very early lighthouse tube which I believe is in working order. It is available for the asking plus 50 cents postage to anyone forming a museum of electronics. I have been collecting circuits for electronic "gadgets" over the past few years, so if anyone of your younger readers or beginners wish to write to me for copies of these and some free advice regarding circuits and components, I will be very pleased to hear from them.

Since it is now over five years since you published a circuit of an RF Signal Generator (March 1968, File No 7 / RO / 41) would you please give some consideration to remedying this situation. Thank you for the very fine magazine — keep up the good work. But I think it is a shame the way the price has increased over the past three years. (M.K. Lawson, 74 Lockheed Street, Garbutt, Qld 4814.)

Thanks for the comments, M.K., we will certainly consider publishing another RF generator. As you can see, we have printed your full name and address so that interested readers may contact you directly.

**VALVES AND TRANSISTORS:** Having been a reader of your magazine for a few years and being interested in the valve / transistor controversy raised by A.B. of Brisbane in the January 1973 issue, I would like to hear your comments concerning my findings when comparing a 20 transistor 20 watt amplifier with a 12 valve 32 watt amplifier, using the same ancillary equipment of very good quality. In my opinion, the valve version has the edge, although small, on the transistor version in all circumstances. How can I measure the differences? (A.K.P., Ralbourne, WA.)

Methods used to measure amplifier performance would normally include the standard tests such as frequency response, noise and distortion, intermodulation, square wave response, and stability, speaker-damping, sensitivity, power output and such like.

These tests would require specialised equipment to provide meaningful results. Most, if not all, have been discussed at some time in the past in "Electronics Australia." It must be remembered that all the ancillary equipment can and does contribute to the final quality of sound and therefore the correct matching of this equipment is important in the final analysis.

By the way, whatever the results of such an exhaustive comparison of performance, they would only allow you to make the decision as to which was the "better" of the two specific amplifiers concerned. The more general question of "valves vs. transistors" would still remain unanswered, as it probably always will.

**PICTURE TUBE REJUVENATOR:** In the "Answers to Correspondents" section of the May 1973 issue a reader (T.S. Waikerie, SA.) was inquiring about a picture tube rejuvenator. You replied that you thought there was one in the "Reader Built It" section some years ago but that there was no file to which quick reference could be made. I was able to make reference to old copies in a library and found the article in question on page 109 of June 1969. I have been collecting "Electronics Australia" for the past three years and consider it the best electronics periodical I have seen. (P.F., Crawley, WA.)

Thank you P.F. for finding the information and taking the trouble to write to us. We trust that it will be seen by T.S. and other interested readers. Thank you also for your kind remarks about the magazine. We hope you continue to enjoy its contents.

*(Continued on page 125)*

## HOW TO USE OUR INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer: (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2). A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 50c per issue-reprint. Thus, a project spread over three issues will cost $1.50. Reprints are available for all projects, but no material can be supplied additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 30c per page.

SUBSCRIPTIONS, BINDERS, HANDBOOKS etc: These are handled by separate departments. For fastest service, send separate orders to the departments concerned.

PHOTOGRAPHS, METAL WORK DRAWINGS: Original photographs are available for most projects, Price: $1 for 6in x 8in glossy print. Metal work dyelines are available for most projects. Price: $1. These show dimensions and positions of holes and cut-outs, but give no wiring details.

PRINTED WIRING PATTERNS: We can supply transparencies, actual size, positive or negative, as specified. Price: 50c. We do NOT deal in manufactured boards. These are available from advertisers.

BACK NUMBERS: As available. On issues up to six months, face value. Seven months to 12 months, face value plus 5c. Thirteen months or older, face value plus 10c. Postage and packing, 10c per issue extra. Please indicate if a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 50c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "Electronics Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

COMPONENTS: "Electronics Australia" does not deal in electronic components. Prices, specifications, etc should be sought from appropriate advertisers or agents.

REMITTANCES: These must be negotiable in Australia, and should be made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque, endorsed with a suitable limitation.

POSTAGE & PACKING: All charges shown include postage and packing, unless otherwise specified.

ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 157, Beaconsfield 2015.

(9 / 73)

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## ANSWERS from p.122

**GUITAR AMPLIFIER:** I am interested in using the power amplifier section of the Guitar Amplifier published in May 1973 (File No 1 / GA / 20) as a utility amplifier. I have a power supply that delivers 25 VDC regulated. How will the amplifier perform with this supply voltage? Under this condition, what signal level would be required at the amplifier input for full power. (J.F., East Bentleigh, Vic.)

Assuming that you adjusted the bias condition of the amplifier for symmetrical clipping at the onset of overload, the maximum power with a 25V supply would be about 8 watts into an 8 ohm load or 4 watts into a 16 ohm load. The input signal required to achieve this power output is about 250 mV RMS.

**RABBIT EJECTOR:** In Forum for July 1973, there is reference to animals being affected by supersonic radiation. I know of a man, a keen rabbiter, who has reportedly seen someone in NSW using a device to induce rabbits to leave their burrows. Involved is "an electronic box with a couple of wires hanging out of it". Can you suggest what such a device would be and therefore help me and my friend to identify with this electronic age? (L.S., Warrnambool, Vic.)

Although some of our staff members have had experience in their boyhood days with picks, shovels, ferrets and nets, we have never come up against less arduous electronic methods. Maybe some reader may be able to tell us what it is all about.

**TRIPLE LIGHT DIMMER:** I am building three dimmers into one diecast box using the circuit published in the April 1973 edition. (File No 2 / PC / 18). Is it necessary to use three supression inductors, one per triac, or would one (or a modified version) do the job adequately? Hope you can help. (D.H., Birkenhead, SA.)

To do the job properly, D.H., it will be necessary to have three complete suppression networks, ie, three capacitors and three inductors. Some shielding between the three circuits may also be necessary, to prevent interaction.

**IGNITION NOISE:** I am seeking information about ignition and alternator noise in a car radio — especially when using a SW converter. I have a number of questions which I would like answered (J.O. Mooroopna, Vic.)

The best thing we can do is refer you to one of our past articles, "Installing a Car Radio" in which most questions will be answered. This article was published in the February 1969 issue under File No 3 / CAR / 11. Reprints are available.

**ELECTRONIC ORGANS:** I would like to thank E.A. and all the enthusiastic and helpful home-organ-constructors for their help recently in overcoming my difficulties in obtaining gold wire. For the benefit of others who may be in trouble obtaining items peculiar to electronic organs I have been advised by the president of the "Electronic Organ Constructors Society", Mr Allan Douglas, that such items may be easily and cheaply obtained from the following address; Mr Allan Douglas, that such items may be easily and cheaply obtained from the following address; Mr A. Douglas, 4 Lees Barn Rd, Radcliffe-on-Trent, Notts, NG12 2DS, England. (J.B.L., Elizabeth Grove, SA.)

Thanks for the kind remarks. As you can see, we have published the information received, and hope that all problems for "home-organ-constructors" will now be solved. Thanks for passing on the information.

**DEAD LETTER:** A letter and reprint material addressed to Mr J. M. Congerton, Flat 23, Park Avenue Apartments, 132 Mounts Bay Rd, Perth, WA 6000 has been returned by the PMG's Department, marked "No longer at this address". If Mr Congerton will advise us of his new address we will forward the material to him.

## 4-CHANNEL DISC from p.57

his saxophone solo was particularly suitable for one track, but this gentle movement becomes obvious only to those who listen rather than just hear.

Referring again to time constants in reverberation systems, we found that a common method used in stereo mix down of delaying the signal through tape delay before feeding the signal into a reverberation plate was generally not as effective as applying the signal directly to a reverberation chamber, without tape delay. However, on two of the tracks, it was found preferable to introduce tape delay ahead of the reverb chamber.

An interesting effect was obtained on one track, where the trumpets and trombones play a staccato section building up to a climax. Here we used a direct tape echo from front to back. We took the signals from the two front channels and fed them into an independent stereo tape recorder, the signals from its replay head being fed into the rear speakers in reverse phase.

You can imagine the effect which would result in paralleling front and rear channels of this quadraphonic mix through two channels for stereo replay!

Some may criticise this deliberate incompatibility. However our justification is that just as a 2-channel recording rarely sounds as good on mono, a 4-channel recording should not be expected to sound as good on a conventional stereo system.

For this reason the 2-channel mix session and the 4-channel mix session were scheduled approximately one week apart, to allow our judgment of balance to be unprejudiced one way or the other.

Whether heard in two channels or four, disc, tape, cassette or cartridge, this recording should provide musical and technical critics with much food for thought.

## NOTES & ERRATA

COURTESY LIGHT DELAY (June 1973, File No 3 / MS / 40): With some combinations of transistors the 47 ohm ½W resistor in the base circuit of the power transistor (2N3055, ASZ16 etc) may tend to overheat. It is recommended that this resistor be changed to 100 ohms, 1W in all cases.

ADDED VERSATILITY FOR YOUR 130 RECEIVER (July 1972, File No 2 / SW / 63): The capacitor from pin 6 of the IC on the FM IF board, page 39, should be marked 0.1uF.

POWERPAC (July 1973, File No 2 / PS / 32): Add to parts list, 1-1k carbon preset tab potentiometer.

SOLID STATE VFO (March 1971, File No 2 / TR / 46): In the Veroboard layout, page 67, a jumper is required between 22G and 22H.

# MARKETPLACE

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**POWER SUPPLY** 12.6V DC 3A regulates to less than 0.2V from 210-270V (no taps) 45-60Hz input. Full overload and short circuit protection. Manufacturers' surplus, brand new in cartons. $29.50 plus freight. PO BOx 360, Brookvale, NSW 2100.

**SUPER BARGAIN PACKS** from **MICRONICS . . . RESISTORS** ½w, 1w, 5%, 10%, Top Quality, ideal for servicing or V.H.F. work or for Hobbyist — 100 for $1. **POLYESTER CAPS** 10% tol., 160, 270, 400v Asst. — 100 for $3.50 (No junk). **CERAMIC DISC CAPS** all miniature — 50 for $1. **ELECTROLYTIC CAPS** (Good quality) — 25 for $2. **TANTALUM CAPS** (Mixed) — 20 for $3. **POTENTIOMETERS** (Mixed) dual, single, switch and Tab pots — 10 for $2.50. **EXPERIMENTERS' DIODES** — 10 for 50c. Post and Pack 20c or extra for heavy parcels. **MICRONICS**, P.O. Box 175, Randwick, N.S.W. 2031.

**ELECTRONICS — SHEET METAL — PLASTICS.** Established Queensland manufacturing company offering facilities, premises, management and staff wishes to receive offers from companies or individuals interested in joint venture, acquisition, or product manufacture under licence, in the fields of electronics, sheet metal, plastics or allied industries. Replies to: MANAGER, Box 1245, GPO, BRISBANE 4001.

**CRO** 5" Heath 10-12 with extras $90.00. RF Signal Generator. Heath 16-102 $40.00. Valve Tester, Heath IT-21 $35.00. All for $150.00. 17 Attunga Road, Miranda, NSW. Phone 524 9929.

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**MONSTER CLEARANCE SALE!!!** Yes we are selling off all these lines at MAD prices so HURRY and stock up now. This month's specials: Polyester Caps (10%) .0022/ 400v — 20 for 20c, Ceramic Disc. .001/ 500v, .0027/ 500v — 20 for 30c, Experimenters' diodes — 10 for 50c. **SEMICONDUCTORS:** BC108 — 10 for $2.90, EM402 (can be used as EM401 as well) — 10 for $1.90, 2N3055 — $1.50 ea., 2N1305 — 50c, 1N662, 1N3666 — 10c ea., AC106BR (Triac) — 80c ea. Top Quality I.C.s Audio amplifiers PA234 1W RMS Audio amp., supply 9 to 22v, output 8, 16 or 22 ohms — only $1.95 (incl. Circuit Diagram). TAA621 4W RMS Audio Amp., supply 9 to 22v, output 8 or 16 ohms — only $4.50 (incl. Circuit Diagram). **ZENER DIODES** (ITT): ZG series (400mw) 1, 2.7, 4.7, 6.2, 10, 15, 18, 27 volts — 30c ea. or 10 for $2.90. ZM series (1.1w) 3.9, 4.7, 5.6, 6.8, 12, 15, 18, 27, 39, 56 volts — 65cea. or 10 for $6.20. ZL series (10w) 3.9, 6, 6.8, 7, 8, 8.2, 18, 27, 39, 180 volts — $1.20 ea. or 10 for $11. **TANTALUM CAPS:** Top Quality miniature type, 5, 7, 30, 40uf (3v), 4, 7uf (6v), 5uf (10v), 1.5uf (15v) — 10 for $1.70. **POLYESTER CAPS:** Top Brand 10%, 160v — .001, .012, .015, .018, .033, .039, .056, .068 — 10 of one value for 50c, .12, .15, .18, .22 — 10 of one value for 70c, .27, .39, .47, .56, .68, .82 — 10 of one value for $1. **ELECTROLYTICS:** 10uf/ 50v, 47uf/ 10v — 10 for 50c. **CERAMIC DISC CAPS:** 10pf, .001/ 50v, 68pf/ 3kv — 20 for 50c. **TRIMPOTS:** miniature PC type (10mm) 500, 1k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1M, 2M — 10 for $1.60. **RESISTORS:** 10 ohm, 1%, ¼w — 10 for 80c. **SPEAKERS:** 6x4 inch, ideal for Car Radio, TV etc. 15 ohm VC — $3 ea. (P.P. 50c). Bank of 4 Push Button switches Push on/ off — 50c. **ROTARY** switch (2pol, 3pos) — 50c ea. Tag Strips: 10 lug — 20 for $1, 3 lug — 20 for 30c. **TRIMMERS:** 12-120pf — 10 for $1. **COILS** Miniature (IR.F., 1 osc 3IF) — 5 for $1.60. **COPPER CLAD BOARDS** 6"x3" — 10 for $1.50. **FERRIC CHLORIDE ETCHANT** (Solid) 100 grm bag — 40c. **MICRO-PACKS** at incredibly low prices. **RESISTORS** 5%, 10%, ½w, 1w ideal for servicing or V.H.F. or hobbyist — 100 for $1 (Top Quality). **POLYESTER CAPS,** Top Quality 160v, 270v, 400v, 10% tol. in a range of values — 100 for $3.50. **POTS,** dual, single, switch and Tab pots (Not Rubbish) — 10 for $2.50. **CERAMIC DISC CAPS** mixed — 50 for $1. (Miniature). **ELECTROLYTIC CAPS** mixed — 25 for $2. **TANTALUM CAPS** asstd — 20 for $3. (Good quality). **HURRY! HURRY!** stocks cannot last. Post Pack 20c or extra for heavy parcels. **MICRONICS,** P.O. Box 175, Randwick, N.S.W. 2031.

**COMMUNICATIONS RECEIVER,** Hallicrafter, TR10 or similar. State age, condition and price in first letter. Gatsby, PO Box 791, ROCKHAMPTON, 4700.

**$1 PAKS** 20 x 10v SIL NPN TRANS. 15 x ¼W ZENERS. SURTRAN, BOX 317, GPO, SYDNEY.

**TWO MTR** 25-151 series STC mobile radio. Two mtr 10-151 series STC mobile radio. Working order. A. Manwaring, PO Box 15, Stockinbingal, NSW 2725.

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**E.M.I.** BTR 1 C Studio tape recorder with many spare parts, mechanically in good order but needs new electronics. Weighs 4CWT! J. Goding, 347 1511 BA, 347 2674 AH, Melbourne.

**TV-Rental**-Service business for sale, shopping centre seaside resort 20 miles north Brisbane. Long lease, dwelling available if wanted. $8500.00, O.N.O., includes van, equipment, stock A.V. and 40 TV rental sets without last $5000.00. Ph. 844168 Brisbane.

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**TAPESPONDENCE** club — Would you like to start an overseas club? Write giving your name and address and phone number, a meeting will then be arranged. If you are country, interstate, or NZ also write. Details will be posted as available. PO Box 311, Milsons Point, NSW 2061.

**ATRA** the club that makes friends with your tape recorder (reel or cassette). SAE, Box 970, GPO, Adelaide, SA 5001.

**RADIO**, tape, stereo, repairs etc. Friendly hobby class, no exams. Thurs. 7 PM. Public School, Wellington Street, Bondi. Details 698 1694.

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*By special arrangement with Dick Smith Electronics Pty Ltd, the October issue of Electronics Australia will be a truly historic one: the first ever to include a complete 64-page electronic parts and kitset catalogue as a FREE lift-out! This is in addition to all the usual features, of course. And among the many constructional projects will be a new low cost digital voltmeter, very easy to build and get going.*

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